This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LANE MEDICAL LIBRARY STANFORD
2 45 0163 7944

G-1.

LIBRARY
OF
Cooper Medical College
DATE
No. 368. SHELF L3
GIFT OF
C. S. Ferris, M.D.

LANE
MEDICAL LIBRARY
SEAL OF THE LELAND STANFORD JUNIOR UNIVERSITY
SEMPER VIRENS
1885
LEVI COOPER LANE FUND

This book is the pr[illegible]
COOPER MEDICAL C[illegible]
SAN FRANCISCO, CAL.
and is not to be removed from the
[illegible] Room by any person or
[illegible] pretext whatever.

G-1.

LIBRARY
OF
Cooper Medical College
DATE
NO. 368. SHELF 23
GIFT OF
C. S. Ferris, M.D.

LANE
MEDICAL LIBRARY
Seal of the Leland Stanford Junior University
Semper Virens
1885
LEVI COOPER LANE FUND

This book is the pr[illegible]
COOPER MEDICAL [illegible]
SAN FRANCISCO, CAL.
and is not to be removed from the
[illegible] *Room by any person or*
[illegible] *any pretext whatever.*

PATHOLOGICAL, DIAGNOSTIC, THERAPEUTIC AND OPERATIVE.

BY

SAMUEL D. GROSS, M.D.,

PROFESSOR OF SURGERY IN THE JEFFERSON MEDICAL COLLEGE OF PHILADELPHIA;
SURGEON TO THE PHILADELPHIA HOSPITAL;
MEMBER OF THE IMPERIAL ROYAL MEDICAL SOCIETY OF VIENNA, ETC. ETC.

ILLUSTRATED BY
TWELVE HUNDRED AND TWENTY-SEVEN ENGRAVINGS.

SECOND EDITION,
MUCH ENLARGED AND CAREFULLY REVISED.

IN TWO VOLUMES.

VOL. I.

LANE MEDICAL LIBRARY
368
SAN FRANCISCO

PRESENTED TO
LIBRARY OF
COOPER MEDICAL COLLEGE,
Dr. A. S. Tevis

Entered according to the Act of Congress, in the year 1859, by

BLANCHARD AND LEA,

n the Office of the Clerk of the District Court of the United States in and for the
Eastern District of the State of Pennsylvania.

PHILADELPHIA:
COLLINS, PRINTER.

TO

THE NUMEROUS PUPILS

WHO, DURING THE LAST QUARTER OF A CENTURY,

HAVE ATTENDED HIS LECTURES,

AND WHO ARE NOW SETTLED IN EVERY SECTION OF THE UNITED STATES

IN THE

HONORABLE PURSUIT OF THEIR PROFESSION,

These Volumes,

DESIGNED TO ILLUSTRATE ONE OF THE MOST IMPORTANT AND VALUABLE BRANCHES
OF THE HEALING ART,

ARE RESPECTFULLY AND AFFECTIONATELY INSCRIBED

BY THEIR FRIEND,

THE AUTHOR.

G-1.

LIBRARY
OF
Cooper Medical College
DATE
NO. 368. SHELF L3
GIFT OF
C. A. S. Ferris, M.D.

LANE
MEDICAL LIBRARY
LEVI COOPER LANE FUND

J. S. Ferris.

PREFACE.

In preparing for the press a new edition of this work, I have carefully revised every chapter, introduced a large amount of new matter, and added nearly three hundred illustrations, a portion of them expressly engraved for its pages. The subject of gunshot wounds, invested at this moment with such a fearful interest on this Continent, has received more than ordinary attention. Notwithstanding these additions, it will be seen that the volumes, in consequence of the employment of a smaller type, are somewhat less bulky than the original ones. The general arrangement of the work is the same as in the first edition; and the new matter will be found to be essentially of a practical nature.

For the flattering manner in which the work has been received by the profession, and for the encomiums bestowed upon it by the periodical press, both at home and abroad, I feel under deep obligations. Such testimony is the highest reward which an author can expect for his labors. A translation of the work into the Dutch language is now in progress at Nieuwediep, in Holland, and will appear at an early day.

To Dr. Richard J. Dunglison I am indebted for important aid afforded me in correcting the press, and in preparing the new index and table of contents.

S. D. GROSS.

Jefferson Medical College,
Philadelphia, January 1st, 1862.

PREFACE TO THE FIRST EDITION.

THE object of this work is to furnish a systematic and comprehensive treatise on the science and practice of surgery, considered in the broadest sense; one that shall serve the practitioner as a faithful and available guide in his daily routine of duty. It has been too much the custom of modern writers on this department of the healing art to omit certain topics altogether, and to speak of others at undue length, evidently assuming that their readers could readily supply the deficiencies from other sources, or that what has been thus slighted is of no particular practical value. My aim has been to embrace the whole domain of surgery, and to allot to every subject its legitimate claim to notice in the great family of external diseases and accidents. How far this object has been accomplished, it is not for me to determine. It may safely be affirmed, however, that there is no topic, properly appertaining to surgery, that will not be found to be discussed, to a greater or less extent, in these volumes. If a larger space than is customary has been devoted to the consideration of inflammation and its results, or the great principles of surgery, it is because of the conviction, grounded upon long and close observation, that there are no subjects so little understood by the general practitioner. Special attention has also been bestowed upon the discrimination of diseases; and an elaborate chapter has been introduced on general diagnosis.

The work, although presented, as its title indicates, as a formal and systematic treatise, is founded upon the courses of lectures which it has devolved upon me to deliver during the last twenty years; first in the University of Louisville, for a long time the most flourishing medical school in the Southwest, and more recently in the Jefferson Medical College of this city, in which I had the honor, in 1828, to receive my degree. During all that period, I have been unceasingly devoted to the duties of an arduous practice, both private and public; to the study of the great masters of the art and science of medicine and surgery; and to the composition of various monographs having a direct bearing upon a number of the subjects discussed in these volumes. The work should, therefore, be regarded as embodying the results of a large personal, if not of a ripe, experience, of extensive reading, and much reflection; in a word, as exhibiting surgery as I myself understand it, and as I have, for so many years, conscientiously taught it. If, upon certain points of doctrine, I have been obliged to differ from colaborers of acknowledged authority and of the highest professional eminence, it is because I have found it impossible to do otherwise. As Luther said at the diet of Worms, "hier stehe ich, ich kann nicht anders," so I may declare that what I have here written, I have written under a solemn conviction of its truth, though certainly not without a strong sense of my fallibility and shortcomings.

In the composition of a work so extensive as this, comprising so many and such diversified topics, no man, however great his opportunities for observation, could possibly rely entirely upon his own resources; for there are certain diseases, and also certain accidents, so infrequent in their occurrence as hardly to come under notice even once in a long lifetime; and it is, therefore, only by availing himself of the recorded experience of the profession that an author can hope to be able to communicate full and satisfactory information respecting them. I have, accordingly, made free use, wherever this was deemed necessary, of the labors of my contemporaries, both among systematic writers and the contributors to the periodical press of this and other countries. To the excellent works of Erichsen, Miller, and Fergusson, so well known on this side of the Atlantic, I have frequently referred as embodying the latest résumé of the art and science of surgery among our British brethren: while I have not neglected to consult some of the more recent treatises in the French and German languages, as well as numerous monographs.

Of the engravings which adorn the volumes, nearly four hundred are original, the remainder having been borrowed from different writers, as Liston, Cooper, Fergusson, Marcet, Bennett, Miller, Curling, Tamplin, Lawrence, W. Jones, Dalrymple, Pirrie, Erichsen, Druitt, Ashton, Toynbee, Barwell, and Mütter. To Mr. Gemrig, the eminent cutler, I am indebted for numerous illustrations, many of them specially prepared for the work, of the latest and most approved styles of instruments. Mr. Kolbe, another excellent manufacturer, has also placed me under obligations for several similar favors.

To Professor Wright, of Montreal, Dr. E. Williams, of Cincinnati, Dr. Lente, of New York, and Dr. Packard, Dr. James Darrach, and Dr. Walter F. Atlee, of this city, my acknowledgments are due for various favors received during the progress of the work. To Dr. Bozeman, of Alabama, a valued friend and former pupil, I am indebted for a complete series of drawings illustrative of his peculiar mode of operating for the cure of vesico-vaginal fistule. The index, which will be found to be unusually elaborate, has been prepared, with great care, by my son, Dr. S. W. Gross.

The mechanical execution of the work will, I doubt not, meet with general approval. The publishers have spared neither pains nor expense to render it as perfect, in this respect, as possible. To Messrs. Baxter and Harley, engravers, and Mr. Collins, printer, my best thanks are due for the able manner in which they have executed their respective tasks.

S. D. GROSS.

July 8, 1859.

A. S. Ferris.

CONTENTS OF VOL. I.

PART FIRST.

GENERAL SURGERY.

PAGE.
Preliminary Observations. 35

CHAPTER I.

IRRITATION, SYMPATHY, AND IDIOSYNCRASY . . 37

CHAPTER II.

CONGESTION. 50

CHAPTER III.

INFLAMMATION.

Sect. I. General Considerations 54
1. Causes of inflammation 55
2. Extension of inflammation 59
3. Varieties of inflammation 61
4. Terminations or events of inflammation 63
II. Acute Inflammation 63
1. Local symptoms 63
2. Constitutional symptoms 72
3. Changes of the blood in inflammation 76
4. Intimate nature of inflammation 79
5. Treatment of inflammation 87
I. Constitutional treatment 88
II. Local treatment 105
III. Chronic Inflammation 116

CHAPTER IV.

TERMINATIONS AND RESULTS OF INFLAMMATION.

Sect. I. Delitescence and Resolution 121
II. Deposition of Serum 122

PAGE
Sect. III. Lymphization or Fibrinous Exudation 125
1. Uses of plastic matter 130
2. Injurious effects of plastic matter 132
Treatment 133
IV. Suppuration and Abscess 134
Abscesses 140
1. Phlegmonous abscess 141
2. Diffuse abscess or purulent infiltration . . . 149
3. Scrofulous abscess 151
4. Multiple abscess or pyemia 156
5. Hectic fever 163
V. Hemorrhage 167
VI. Mortification 168
1. Acute mortification 169
2. Chronic mortification 177
VII. Hospital Gangrene 182
VIII. Ulceration and Ulcers 189
Ulcers 192
1. Acute ulcers 194
2. Chronic ulcers 197
IX. Granulation 205
X. Cicatrization 207

CHAPTER V.

TEXTURAL CHANGES.

Sect. I. Softening 210
II. Induration 211
III. Transformations 213
IV. Hypertrophy 216
V. Atrophy 218
VI. Contraction and Obliteration 220
VII. Fistule 221

CHAPTER VI.

CONGENITAL MALFORMATIONS. . . . 225

CHAPTER VII.

TUMORS OR MORBID GROWTHS.

Sect. I. General Observations 228
II. Benign Tumors 231
1. Hypertrophic tumors 232
2. Vascular tumors 233

PAGE
5. Wounds inoculated with a peculiar septic poison generated in dead animal bodies 362
    a. Dissection wounds 362
    b. Malignant pustule 367

CHAPTER X.

EFFECTS OF INJURIES UPON THE NERVOUS SYSTEM.

SECT. I. Prostration, Collapse, or Shock 371
II. Traumatic Delirium 376

CHAPTER XI.

SYPHILIS.

SECT. I. General Considerations 381
II. Primary Syphilis 383
    1. Chancre 383
    2. Bubo 401
III. Secondary Syphilis 406
    1. General considerations 406
    2. Affections of the skin 409
    3. Alopecia 413
    4. Syphilitic abscesses 414
    5. Cervical adenitis 414
    6. Affections of the mucous membranes 415
IV. Tertiary Syphilis 418
    1. General considerations 418
    2. Syphilis of the throat and mouth 420
    3. Syphilis of the nose 421
    4. Syphilis of the larynx 421
    5. Syphilis of the eye 422
    6. Syphilis of the ear 423
    7. Syphilis of the skin 423
    8. Syphilis of the osseous system 425
    9. Syphilitic orchitis 428
    10. Condylomatous growths 430
    Treatment 432
    Syphilis in the infant 440
    Syphilization 444

CHAPTER XII.

GENERAL DIAGNOSIS.

SECT. I. Examination of the Patient 446
    Examination of the different organs 448
II. Mensuration 453
III. Attitude of the Patient 454

PAGE
SECT. IV. **External Characters** 455
V. **Instrumental Explorations** 458
VI. **Examination of the Discharges** 463
VII. **Microscopical Examination** 465

CHAPTER XIII.

MINOR SURGERY.

SECT. I. **Instruments** 472
II. **Incisions** 476
III. **Avulsion, Enucleation, Ligation, and Crushing** 480
IV. **Abstraction of Blood** 483
V. **Transfusion of Blood** 492
VI. **Vaccination** 493
VII. **Counter-irritation** 494
VIII. **Escharotics** 499
IX. **Dressing** 501
X. **Bandaging** 503

CHAPTER XIV.

OPERATIVE SURGERY.

Qualifications of a surgeon 508
Preparation of the patient 510
Assistants 513
Duty of a surgeon 514
Position of the patient and surgeon 515
Operation 515
  Accidents during the operation 515
  Dressings and after-treatment 516
  Dangers after operation 518

CHAPTER XV.

PLASTIC SURGERY 524

CHAPTER XVI.

SUBCUTANEOUS SURGERY 529

CHAPTER XVII.

AMPUTATIONS IN GENERAL.

PAGE
SECT. I. Introductory Considerations 533
II. Circumstances Demanding Amputation 534
III. Methods of Amputation 540
IV. Operation and after-treatment 546
Synchronous Amputation 551
V. Affections of the Stump 552
1. Primary affections 552
2. Secondary affections 555
VI. Constitutional Effects of Amputations 557
VII. Artificial Limbs 560
VIII. Mortality after Amputations 563

CHAPTER XVIII.

EXCISION OF THE BONES AND JOINTS.

Instruments 571
Position of the patient 573
Incisions 573
Removal of the bone 574
Dressing 574

CHAPTER XIX.

ANÆSTHETICS OR THE MEANS OF AVERTING PAIN.

General considerations 575
Chloroform 579
Mode of administration 580
Effects 582
Inhalation of ether 584
Amylene 585
Kerosoline 585
Local anæsthesia 585

CHAPTER III.

DISEASES OF THE LYMPHATIC VESSELS AND GANGLIONS.

PAGE
SECT. I. Lymphatic Vessels 657
II. Lymphatic Ganglions 659

CHAPTER IV.

DISEASES AND INJURIES OF THE NERVES.

SECT. I. Wounds and Contusions 665
II. Tetanus 667
III. Neuralgia 675
IV. Paralytic Affections 682
  1. Wasting palsy 682
  2. Infantile palsy 686
  3. Partial palsy 687

CHAPTER V.

DISEASES AND INJURIES OF THE ARTERIES.

SECT. I. Wounds and Hemorrhage 689
II. Subcutaneous Hemorrhage 709
III. Collateral Circulation 710
IV. Hemorrhagic Diathesis 714
V. Diseases of the Arteries 717
  1. Acute inflammation 717
  2. Chronic affections 719
  3. Intra-parietal separation 722
  4. Varicose enlargement 723
VI. Aneurism 723
  1. Locality, prevalence, age, sex, and causes 725
  2. Varieties 729
  3. Symptoms 734
  4. Diagnosis 736
  5. Effects and termination 738
  6. Spontaneous cure 739
  Treatment 743
  a. Deligation of the artery at the cardiac side of the tumor . 744
  b. Deligation of the artery at the distal side of the tumor . . 747
  c. Instrumental compression 749
  d. Digital compression 752
  e. Forcible flexion 754

PAGE
f. Galvano-puncture . . . 754
g. Injection . . . 755
h. Manipulation . . . 757
i. Valsalva's treatment of internal aneurism . . . 757
k. General medical treatment . . . 759
False aneurism . . . 759
Sect. VII. Aneurism of Particular Arteries . . . 763
of the thoracic aorta . . . 763
of the innominate artery . . . 766
of the common carotid artery . . . 772
of the external carotid . . . 779
of the ophthalmic artery . . . 779
of the internal carotid . . . 780
of the vertebral artery . . . 780
of the subclavian . . . 781
of the axillary artery . . . 785
of the brachial artery and its branches . . . 791
of the common iliac artery . . . 792
of the internal iliac . . . 794
of the external iliac . . . 794
of the femoral artery . . . 796
of the popliteal artery . . . 798
of the arteries of the leg and foot . . . 801
VIII. Operations on the Arteries . . . 802
Ligation of the innominate or brachio-cephalic . . . 802
of the common carotid . . . 803
of the external carotid and its branches . . . 806
of the vertebral artery . . . 809
of the subclavian artery . . . 809
of the axillary . . . 813
of the brachial . . . 814
of the radial and ulnar . . . 816
of the abdominal aorta . . . 816
of the common iliac . . . 817
of the internal iliac . . . 819
of the gluteal . . . 820
of the sciatic artery . . . 821
of the external iliac . . . 821
of the epigastric and circumflex arteries . . . 822
of the femoral . . . 823
of the deep femoral . . . 825
of the popliteal . . . 826
of the anterior tibial . . . 826
of the posterior tibial . . . 827
of the peroneal . . . 829

CHAPTER VI.

INJURIES AND DISEASES OF THE VEINS.

Sect. I. Wounds . . . 830
II. Diseases of the Veins . . . 831

This book is the pr
COOPER MEDICAL C
SAN FRANCISCO CAL

PAGE
1. Acute phlebitis 831
2. Chronic affections 833
SECT. III. Varix 834
IV. Introduction of Air 837

CHAPTER VII.

AFFECTIONS OF THE CAPILLARIES.

SECT. I. Arterial Tumors 842
II. Venous Tumors 849

CHAPTER VIII.

DISEASES AND INJURIES OF THE BONES AND THEIR APPENDAGES.

SECT. I. Periostitis 851
Acute periostitis 852
Chronic periostitis 853
II. Endosteitis or Osteomyelitis 854
III. Osteitis 856
IV. Suppuration and Abscess 860
V. Caries or Ulceration 862
VI. Necrosis or Mortification 871
VII. Softening 882
VIII. Rachitis 886
IX. Fragility 890
X. Atrophy 893
XI. Hypertrophy 894
XII. Tumors 896
Innocent formations 896
1. Exostoses or bony tumors 896
2. Fibro-cartilaginous tumors 901
3. Aneurismal tumors 902
4. Hematoid tumors 904
5. Sero-cystic tumors 904
6. Hydatic tumors 907
7. Myeloid tumors 909
Malignant formations 910
XIII. Tubercular Disease 913
XIV. Neuralgia 915
XV. Fractures 917
1. General considerations 917
2. Simple fractures 924

LIST OF ILLUSTRATIONS TO VOL. I.

FIG. PAGE
1. Reticulated arrangement of the corpuscles in inflammatory blood . . 78
2. Buffy and cupped blood 79
3. Natural ear of a rabbit 82
4. Inflamed ear of a rabbit 82
5. Extravasated blood in an inflamed serous membrane . . . 82
6. Changes in the capillary circulation in inflammation . . . 83
7. Plastic corpuscles and filaments in recent lymph exuded on the pleura . 128
8. Recent lymph, forming false membrane 128
9. } 10. } Nuclei and cells developing themselves into fibres . . . 128
11. Perfect fibrous tissue 128
12. Newly-formed vessels in plastic lymph 129
13. Vessels in false membrane of the pleura 129
14. Natural appearance of pus corpuscles and after the application of acetic acid 137
15. Abscess opening into the external carotid 146
16. Bistoury for opening abscesses 147
17. Acute mortification 170
18. Mortification, with an appearance of the sloughing process . . 173
19. Chronic gangrene 178
20. Chronic ulcer 199
21. Granulating ulcer, beginning to cicatrize 202
22. Strapping of an indolent ulcer 203
23. Arrangement of bloodvessels in a granulation 205
24. Structure of a cicatrice of the skin 208
25. Vascular tumor of the scalp 234
26. Fatty tumor 235
27. Minute structure of a fatty tumor 236
28. Horny excrescence of the scalp 238
29. Section of a horn 239
30. Microscopical characters of a fibrous tumor 241
31. Enchondromatous tumor 243
32. Minute structure of enchondroma 243
33. Section of a neuromatous tumor 246
34. Microscopic structure of a neuromatous tumor 246
35. Painful subcutaneous tubercle 247
36. Microscopic structure of the subcutaneous tubercle 247
37. Hydatids inclosed in a common cyst 250
38. Cysts of echinococci 251
39. Echinococci 251

FIG. PAGE
40. Serrefine 256
41. Small forceps for temporarily checking hemorrhage 256
42. Cancer-cells in the earlier stages 258
43. Cancer-cells further developed 258
44. Cancer-cells in their fibrous stroma 258
45. Stroma of scirrhus 261
46. Scirrhus cells 261
47. Stroma of encephaloid 265
48. Encephaloid cells 266
49. Tuberoid form of encephaloid 266
50. Epithelial cancer in a state of ulceration 269
51. Cells of epithelioma 270
52. Papilla from epithelioma 270
53. Colloid tumor, external appearance 272
54. Colloid tumor, internal structure 272
55. Microscopic structure of a melanotic tumor 274
56. Tubercle corpuscles 289
57. Tubercles in the mesenteric glands 289
58. Interrupted suture 302
59. Silver needle for twisted suture 302
60. Twisted suture, elliptical 302
61. Twisted suture, figure of 8 302
62. Pin pliers 303
63. India rubber suture 303
64. Glover's suture 304
65. Quilled suture 304
66. Price's needle for wire suture 305
67. Murray's needle 305
68. Lister's needle 305
69. 70. } Invaginated bandage for longitudinal wounds 306
71. Diagram representing effects of gunshot wounds 326
72. 73. } Gunshot probe 334
74. Bullet forceps 335
75. Tiemann's forceps 335
76. Gemrig's forceps 336
77. Gross's forceps 336
78. Kolbe's bullet extractor 336
79. European extractor 336
80. Head of rattlesnake 348
81. Poison fang, magnified 348
82. Indurated chancre 386
83. Sloughing chancre 388
84. Acute phagedena 389
85. Chronic phagedena 389
86. Syphilitic ulceration of the larynx 422
87. Syphilitic rupia 425
88. Syphilitic caries of the skull 427
89. Syphilitic hypertrophy of the femur, internal structure 427
90. Syphilitic hypertrophy of the femur, external characters . . . 428
91. Condylomata 431

FIG. PAGE
92. Syphilitic temporary teeth 443
93. Syphilitic permanent teeth 443
94. Probe 459
95. Speculum 460
96. Exploring needle 461
97. Smith and Beck's large compound microscope 466
98. Arrangement of microscope for transparent objects . . . 467
99.
100.
101.
102. Scalpels 473
103.
104.
105. Bistoury 473
106. Sharp-pointed bistoury 474
107. Probe-pointed bistoury 474
108.
109. Forceps 474
110.
111. Scissors 474
112. Museux's forceps 475
113. Pronged instrument for pulling and holding tumors . . . 475
114. Forceps for uterine polyps 475
115. Grooved director 475
116. Trocar 476
117. Needles 476
118. Suture needle 476
119. First position in holding scalpel 477
120. Second position in holding scalpel 477
121. Third position in holding scalpel 477
122. Fourth position in holding scalpel 477
123.
124.
125.
126.
127. Different forms of incisions 479
128.
129.
130.
131.
132. Double canula 481
133. Ecraseur 481
134. Scarificator 485
135. Cupping apparatus 485
136. Cupping glass with India-rubber top 486
137. Veins of arm 488
138. Mode of holding the lancet in venesection 489
139. Compress applied to the temporal artery after arteriotomy . . 492
140. [illegible]'s transfixing apparatus 493
141. Corrigan's button cautery 495
142. Seton needle armed 496
143. Eye probe as a substitute for the above 496

FIG. PAGE
144. Porte-moxa 497
145.
146. } Acupuncture needles 498
147.
148. Marshall's galvanic cautery 499
149. Different forms of cauteries 500
150. Dressing forceps 501
151. Bandage of Scultetus 504
152. Mode of applying the bandage 505
153. Appearance of the bandage after its application 505
154. Gangrene from strangulation by unequal compression of a bandage . 506
155. Tenotome 531
156. Circular amputation, illustrated in the leg 541
157. Circular operation, shown in the thigh 542
158. Corresponding stump 542
159. Flap amputation, illustrated in the thigh 544
160. Corresponding stump 544
161. Amputation by the rectangular flap (Teale's process) 545
162. Appearance of parts when brought together in the same 545
163. Tourniquet of Petit 547
164. Tiemann's improved tourniquet 547
165. Gross's arterial compressor 548
166. Amputating knife 548
167. Catlin 549
168. Amputating saw 549
169. Small amputating saw 549
170. Bone nippers 549
171. Detached sequester 555
172. Neuromata of the stump, after amputation of the arm 556
173. Appearance of bony stump after amputation 560
174. Palmer's artificial leg 561
175. Ordinary form of wooden leg 563
176. Palmer's artificial arm 563
177. Butcher's saw 572
178. Hey's saw 572
179. Narrow concave saw for division of bones 572
180. Chain saw 572
181.
182. } Cutting pliers 573
183.
184. Carbuncle in its forming stage 606
185. Ulcerated carbuncle 606
186. Cicatrice after a burn 613
187. Sebaceous tumor of the scalp 623
188. Cyst of a sebaceous tumor containing hair 624
189. Elephantiasis of the foot and leg 628
190. Keloid tumors 632
191. Microscopical characters of keloid 634
192. Nodule of black cancer in the skin 639
193. Globular hydatid 646
194. Fibroid bodies of a ganglion 650
195. Fibroid bodies of a synovial burse 654

FIG. PAGE
196. Hypertrophied lymphatic glands 660
197. Melanosis of a lymphatic gland 663
198. Cretaceous degeneration of lymphatic glands 663
199. Syringe for endermic application of morphia 680
200. Plan of wounded arteries 690
201. Contraction of a divided artery 691
202. Plan of natural hemostatics in a cut artery 691
203. Change in artery after ligation 692
204. Diagram of the collateral circulation 692
205. Spring artery forceps 694
206. Tenaculum 694
207. Sliding forceps 695
208. Mode of isolating an artery 695
209. Effects of ligation on the inner coats 695
210. Exterior of an artery after ligation 696
211. Reef-knot 696
212. Surgeon's knot 696
213. Tenaculum-needle, armed with ligature 697
214. Physick's artery forceps 697
215. Aneurism-needle, armed with ligature 698
216. Carotid of a dog forty-eight hours after deligation 699
217. Carotid of a dog ninety-six hours after deligation 699
218. Carotid of a dog twelfth day after deligation 699
219. Acupressure; the pin seen through the skin 702
220. Position of the artery and pin in acupressure 702
221. Tourniquet applied to the thigh 702
222. Field tourniquet; handkerchief and stick 703
223. Field tourniquet; handkerchief and sword 703
224. Prussian field tourniquet 703
225. Compression of the fingers, arresting the circulation in the upper extremity 704
226. Compression of the fingers, arresting the circulation in the lower extremity 704
227. Plan of a graduated compress 705
228. Torsion-forceps 707
229. Partial absorption of the clot 709
230. Collateral circulation shown in the thigh 713
231. Deposition of calcareous matter in an artery 720
232. Atheromatous deposits in the aorta 720
233. Minute appearances of atheromatous deposits 721
234. Dissecting aneurism 722
235. Varicose enlargement of the arteries 723
236.
237.
238.
239. Arrangement of arterial tunics in spontaneous aneurism . . 724
240. Sacculated aneurism 729
241. Aneurism of aorta 730
242. Sacciform aneurism of aorta ready to give way 731
243. Tubular aneurism of aorta 733
244. Aneurism by dilatation 734
245. Erosion of vertebræ from aneurism 739
246. Aneurism obliterated by deposition and organization of fibrin . . 740
247. Aneurism of descending aorta; burst 742

FIG. PAGE
360. Fracture of the glenoid cavity 976
361. Fracture of the coracoid process 976
362. The ordinary situation of fracture of the body of the scapula . . 977
363, 364. Fractures of the ribs, showing direction of displacement . . 979
365. Fracture of the ribs—united by osseous matter 981
366. Fracture of the spinous process 984
367. Fracture of the vertebral arches 984
368. Fracture of the vertebræ 985
369. Fracture of the odontoid process of the axis 986
370. Fracture of the acetabulum 986
371. Fracture of the pubic and ischiatic bones 987
372. Fracture of the shafts of the radius and ulna 989
373. Vicious union after fracture of the shaft of the radius . . . 989
374. Fracture of the shaft of the ulna 990
375, 376. Fracture of the olecranon process 991
377. Fracture of the olecranon process, united by fibrous matter . . 991
378. Apparatus for the same 992
379. Fracture of the coronoid process 992
380. Apparatus for the same 993
381. Fracture of the shaft of the radius 994
382. Fracture of the head of the radius 995
383. Multiple fractures of the lower extremity of the radius . . . 996
384. Fracture of the lower extremity of the radius 997
385. Fracture of the lower end of the radius, complicated with luxation of the ulna 997
386. Bond's splint—the part for the back of the forearm . . . 998
387. The same, for the front of the forearm and hand 998
388. Apparatus for fracture of the lower end of the radius . . . 999
389, 390, 391. Dr. Swinburne's apparatus for fracture of the radius . . 999
392. Fracture of the inner condyle of the humerus 1001
393. Fracture of the outer condyle of the humerus 1001
394. Fracture of the inferior extremity of the humerus 1002
395. Complicated fracture of the elbow 1003
396. Fracture with detachment of the head of the humerus . . . 1004
397. Fracture of the anatomical neck of the humerus 1005
398. Fracture of the surgical neck of the humerus 1005
399. Welch's shoulder splints 1006
400. Oblique fracture of the tibia 1010
401. Tin case for fracture of the tibia 1010
402. Welch's splints for fracture of the tibia 1011
403. Bauer's wire splints for fracture of the tibia 1011
404. Vertical fracture of the fibula 1012
405. Dupuytren's apparatus for fracture of the lower extremity of the fibula . 1013
406. Fracture of the tibia and fibula 1015
407. Fracture of the extremity and malleolus of the tibia and the lower end of the fibula 1015
408. Appearances of the broken articulating surface of the tibia . . 1015
409. Fracture of the lower end of the tibia and fibula 1016
410. Neill's fracture-box 1017
411. Extension in fractures of the leg by the gaiter 1017
412. Extension in fractures of the leg by the handkerchief . . . 1017
413. Extension in fractures of the leg by adhesive strips . . . 1017

FIG. PAGE
414. Swinburne's mode of treating fracture of the leg 1018
415. Salter's apparatus for suspending the leg 1018
416. Smith's double-inclined plane 1019
417. Complicated fracture of the leg 1019
418. Fracture box 1021
419. M'Intyre's screw splint for compound fracture of the leg . . . 1021
420, 421. Fracture of the patella 1021
422. Signs of the same 1022
423. Separation of the fragments in fracture of the patella . . . 1023
424. Hamilton's apparatus for the same 1024
425, 426, 427. Fracture of the upper portion of the shaft of the femur . . 1027
428. Fracture of the inferior fourth of the shaft of the femur . . . 1028
429. Jenks's fracture-bed 1029
430. Physick's long splint 1031
431. Gross's fracture-box 1031
432. Gilbert's apparatus for compound fractures of the thigh-bone . . 1032
433, 434. Hedge's mode of counter-extension in fracture of the femur . 1032, 1033
435. Smith's anterior splint 1033
436. Mode of application of the same 1034
437. Buck's fracture apparatus 1034
438. Swinburne's treatment of fractured thigh, without splints . . . 1035
439. Double inclined plane of Sir Charles Bell 1037
440. M'Intyre's splint, simplified and improved by Liston . . . 1038
441. The same applied to the limb 1038
442. Fracture of the external condyle of the thigh-bone . . . 1039
443. Comminuted vertical fracture of the condyles of the femur . . 1040
444. Normal appearances of the head and neck of the thigh-bone . . 1041
445. Changes in the head and neck of the thigh-bone from old age . . 1041
446. Capsular ligament of the thigh-bone 1042
447, 448, 449. Intra-capsular fracture of the neck of the thigh-bone . 1043, 1044
450. Vertical fracture of the neck of the femur 1044
451. Senile atrophy of the neck of the femur 1049
452. Atrophy which might be mistaken for united fracture . . . 1049
453. Fibro-ligamentous union of the neck of the thigh bone . . . 1049
454. Daniel's fracture-bed 1052
455, 456. Extra-capsular fracture of the neck of the thigh-bone . . 1053
457. Impacted fracture of the neck of the femur 1056
458. Impacted fracture through the trochanters 1056
459. Fracture of the great trochanter 1061
460. Sir Astley Cooper's mode of treating fractures of the great trochanter . 1062

PART FIRST.

GENERAL SURGERY.

day, forms one of the brightest pages in the history of human progress and human achievement. Redeemed and purified by the genius of modern discovery, it is no longer a handicraft, but a science and an art, reduced, if not to perfection, to principles as accurate as any that have been introduced into the study of the natural sciences in general, of which, in fact, it forms one of the most interesting and useful branches.

Surgery, thus improved and perfected, can no longer be separated from medicine; any attempt to produce such a severance must prove abortive. They are, in point of fact, one and the same science, and therefore indivisible. No surgeon can practise his profession with credit to himself, or benefit to his fellow-creatures, if he is not an enlightened physician, or deeply grounded in a knowledge of the great doctrines of disease. He may, it is true, be an excellent operator, a good mechanic; but unless he is an able pathologist and therapeutist, he is unworthy to be intrusted with the health and life of the humblest citizen.

Surgery has occasionally been separated into two distinct branches, medical and operative; the former treating, as the name implies, of the principles of the science, or of the nature of disease, and of its management by drugs; the latter, of the various manual, instrumental, and mechanical procedures considered necessary for the cure of external affections, and the repair of mutilated structures. Upon this plan have been constructed several very excellent modern works, as those of Liston, Miller, Fergusson, Sédillot, Blasius, Velpeau, Pancoast, and Smith; but it is questionable whether such a manner of treating the subject is altogether judicious, as it is certainly calculated to invest the operative part of surgery with a degree of importance that does not legitimately belong to it, and which may lead, especially on the part of the young practitioner, to erroneous conceptions of the true province and dignity of surgery, considered as a science and an art. A work on surgery, or, indeed, on any subject, without principles, may be compared to a vessel at sea without helm or rudder to guide it to its place of destination. If, therefore, there is any one part of the present treatise upon the study of which I would insist more than upon that of any other, it is that which treats of the great principles of surgery, as comprised under the head of inflammation, wounds, morbid deposits, new growths, and morbid poisons. Let the student make himself fully acquainted with these details, and he can hardly fail to become an enlightened and judicious practitioner. Let him learn principles, and he will be able to form a more just appreciation of what is merely operative.

CHAPTER I.

IRRITATION, SYMPATHY, AND IDIOSYNCRASY.

It is perhaps impossible, in the present state of the science, to offer any satisfactory definition of irritation, or to assign to this expression its true pathological and practical import, without an intimate knowledge of sympathy, or of those various and mysterious relations, anatomical and functional, which exist among the different organs and tissues of the body, and which thus serve to bind them all up into one harmonious, uniform, and connected system. Irritation and sympathy are not only closely associated together, in all the great operations of the economy, but they so constantly run into each other, as to render it impossible always to draw a precise line of distinction between them, or to determine what part they respectively play in the production, propagation, and effect of disease. Much of what has been written upon these topics has necessarily been exceedingly obscure, depending not merely upon the intrinsic difficulties of the subject—great and perplexing as they certainly are—but upon the unphilosophical manner in which they have, for the most part, been discussed by surgeons, whose authority has not only never been disputed, but regarded with a blind devotion as surprising as it has generally been unaccountable. To arrive at any other conclusion from an attentive perusal of their writings, is impossible. Every page, nay, almost every paragraph, bears testimony to the fact that they have constantly confounded together affections of a very different, and even of an opposite nature; that they have, in numberless instances, violated their own definitions of disease; and that they have attempted to establish systems of treatment based upon principles of the most erroneous and unfounded character.

What is irritation? Is it an entity, or a mere myth, a certain undefinable something, which no one can see, but which every one may recognize by its effects? Perhaps the best definition we can give of it is, that it is a disordered state of the nerves of the affected part, attended with more or less pain and functional disturbance, but not with inflammation, although it may lead to that result, if not timeously arrested; in other words, irritation is a disease whose predominant symptom is nervous derangement. Viewed in this light, it may be considered as bearing the same relation to the nervous system that inflammation bears to the vascular; the one consists essentially in disordered sensation, the other in disordered circulation; in the one there is pain, but it is the pain of perverted sensation, in the other there is pain also, but it is the pain of inflammation, as is evinced by the concomitant vascular injection, discoloration, and tumefaction, which are wanting in the former. The differences between irritation and inflammation have sometimes been defined by stating that the former terminates where the latter begins; just as congestion may be said not to be inflammation, but the prelude to that affection. Both may be merged in the latter disease, and may, consequently, serve to augment and perpetuate it.

Irritation may be of limited extent, as when it is confined to one particular organ, or part of the body, and is then said to be local; on the other hand, it is sometimes widely diffused, manifesting itself at numerous points, and constituting what is termed general irritation, of which one of the most familiar illustrations occurs in nervous shock, consequent upon severe injury. It is also divided into direct and indirect; in the former case, the irritation displays itself at the place of the morbific impression; in the latter, on the contrary, it occurs at a situation more or less remote, sympathy and reflex action being the agents of its transmission. An example of direct irritation is afforded in the intolerance of light which results from over-fatigue of the eye, and of the indirect, in the convulsions which supervene upon the presence of worms in the alimentary canal, the irritation being communicated here from the nerves of the bowels to the spinal cord, or the cerebro-spinal axis, and from thence to the nerves of the voluntary muscles, the seat of the spasmodic action.

Local irritation may manifest itself in a great variety of ways and circumstances. It is generally excited by the contact of some extraneous substance, or agent, foreign to the part, and, therefore, a source of offence to it. Thus, a drop of alcohol, falling upon the eye, instantly produces pain, and injection of the conjunctiva, with an abundant flow of tears; the organ resents the aggression, and the consequence is a marked perversion both of sensation and circulation, which, the exciting cause ceasing to operate, soon passes off, the parts regaining their comfort and accustomed action; or, the cause continuing in play, violent and even destructive inflammation may succeed, the minor evil being merged into the major. A pinch of snuff will excite sneezing by the irritation which its presence induces in the pituitary membrane; on the same principle, some emetics cause vomiting, some cathartics purging, and some diuretics an increased secretion of urine. When the hand is held near a hot stove, or rubbed with spirits of ammonia, the skin presently shows signs of irritation; its sensibility is perverted, it burns and stings, and becomes intensely red. All these, and numerous other analogous cases that might be easily adduced, if it were necessary, are examples of local irritation, or of perverted nervous action, accompanied by vascular determination, but not by inflammation, although such an event is certain to occur, if the exciting cause of the irritation be not promptly removed.

Indirect, or reflex irritation, like the direct, also displays itself in different ways, and not unfrequently in a manner not less singular than perplexing, defying all effort at explanation. The subject offers a wide field for contemplation and study. Time and space will permit me to glance only at a few of the more prominent facts which naturally connect themselves with such a discussion. To do anything even like partial justice to the subject, it will be proper to consider it in relation to the principal organs of the body, a procedure which will necessarily bring up the question of sympathy, as a knowledge of the latter is indispensable to a correct appreciation of the former, and conversely.

It would be out of place in a work of this kind to inquire into the nature of sympathy. All that we know respecting it is, that there exists, both in health and in disease, an intimate relationship between certain organs and tissues, the result either of a continuity of structure, similarity of tissue, or of ties, of which anatomy and physiology have failed to point out the true character. In health, this action is carried on so imperceptibly as to escape attention; but, whenever there is any serious disorder of the system, it manifests itself at every point, serving at once, at least in many cases, to indicate the nature of the lesion, and the particular tissues, or set of textures, which it implicates. It is not difficult to account for the sympathy that exists between parts that are united together by continuity of structure, as, for instance, the eye and nose, or the bladder and urethra; or by similarity of structure, as the fibrous membranes, whose diseases, as gout and rheumatism, are sometimes suddenly transferred from one to another; but, in other cases—and these constitute some of the most interesting and important exceptions—no connection of any kind can be traced, and we are therefore left in doubt in respect to its real character. It is only, then, by studying these effects, as they exhibit themselves in different parts of the body, and under different circumstances, that our knowledge of them can be made practically available at the bedside.

1. *Brain.*—The brain, from its elevated position in the scale of organs, and its importance to health and life, is subject, in a remarkable degree, to the causes which develop and influence irritation. Connected, either directly or indirectly, with every other organ and tissue of the body, its functions are liable to be disturbed in every variety of way, and in every possible degree, from the most simple and almost imperceptible departure from the normal standard to the most complete and thorough perversion, amounting, at times, to total annihilation of sensation. Hence, it is not surprising that while the brain is itself a source of irritation to other parts, it should, in its turn, be more or less seriously affected by irritation having its seat in remote structures operating upon it through sympathy, or reflex action. It is in this manner that are developed many of the most distressing diseases of the cerebrum and cerebellum, and, also, as a natural consequence, of the mind; and, what is remarkable is, that some of the most disastrous lesions often have their origin in apparently the most trivial cerebral irritation, which, but for neglect or ignorance, might usually be relieved by the most simple treatment. The arachnitis of infancy generally begins in reflex irritation, which has its seat in the bowels, stomach, liver, skin, or gums, fretted, perhaps, by the pressure of an advancing tooth. Such cases are of constant occurrence in this country, during our hot summer months, and there are none which are more justly dreaded by the practitioner. The influence of this kind of irritation is often forcibly exhibited in traumatic delirium, or that excited state of the brain consequent upon accidents and operations, especially in subjects of intemperate habits and of a nervous temperament; the brain appears to be in a state of the utmost tension from pent-up irritability, which nothing but the most liberal use of anodynes can generally control; all the symptoms are such as to preclude the idea of the existence of inflammation in the cerebral substance, nor is it by any means certain that there is always gastritis, although usually there is marked derangement of the stomach. In disorder of the uterus, the brain is often affected by reflex irritation, as is plainly evinced by the eccentric phenomena which so generally attend hysterical diseases.

On the other hand, disease of the brain is often productive of serious irritation, or disease in other parts. Thus, after concussion of this organ, it is by no means uncommon, after the main symptoms of the accident have subsided, to meet with paralysis of one side of the face, occasional vomiting, constipation of the bowels, irritability of the bladder, or disease of the sphincters, causing involuntary discharges of urine and feces.

The sympathetic relations between the cerebellum and testes have always been a matter of observation, and afford a ready explanation of the occurrence of certain diseases, which, but for a knowledge of this fact, would be impossible. Military surgeons long ago noticed that wounds of the occiput, even when they do not involve the substance of this portion of the brain, are often followed, at variable periods after recovery, by atrophy of the testicles. Injuries of the cerebellum have been known to be succeeded within a short time after their infliction by the most violent sexual excitement. In a case of gunshot wound, the particulars of which have been related to me by Dr. Donne, of Kentucky, this sexual irritation existed in a most remarkable degree. The man was twenty-five years of age, and the ball, discharged from a common rifle, penetrated the skull near the lambdoidal suture, whence it passed obliquely downwards and backwards, lodging, there was every reason to and disease, or to combat them successfully when their development has been unavoidable.

6. *Stomach.*—The stomach, possessing a wide range of sympathy, is often the seat, not less than the cause, of severe irritation. Food and drink are the natural stimulants of this organ, and, rationally employed, seldom fail to prove wholesome. But when the laws of digestion are contravened by dietetic debauch and indiscretion; or, in other words, when the stomach is overloaded with indigestible articles, nausea and vomiting, with more or less cerebral and other disturbance, are the necessary and inevitable consequences. In children and delicate nervous females, such abuse often manifests its effects in the most violent convulsions, from the irritation it provokes in the cerebro-spinal axis and the nerves which are distributed to the voluntary muscles. An overloaded stomach frequently brings on a severe attack of asthma, palpitation of the heart, indistinctness of vision, and distressing noises in the ears.

Affections of the œsophagus often create excessive irritation of the stomach, manifesting itself in nausea and vomiting. Examples of this morbid sympathy occur in scirrhus of the œsophagus, as well as in ulceration and ordinary stricture of that tube. I have seen a foreign body, as a common cent, lodged in the œsophagus of a child, keep up nausea and vomiting until it was extracted. The irritation of the stomach, produced by tickling the fauces, is well known to every one. On the other hand, the œsophagus is liable to suffer very seriously from disease of other parts of the body. Thus, spasmodic stricture of this tube, sometimes of an exceedingly severe and intractable character, may be produced by disorder of the stomach, bowels, uterus, or spinal cord, which can only be relieved by addressing our remedies to the seat of the primary affection.

7. *Bowels.*—Disorder of the bowels is a prolific source of irritation, exhibiting itself in different viscera and tissues; for there are few organs whose sympathetic relations are of a more varied and extensive character. We have already alluded to the effects occasioned by the presence of worms in the alimentary canal; the retention of irritating matter often produces similar impressions upon the great nervous centres, followed, in many cases, especially in infants and delicate nervous persons, by violent convulsions, disease of the arachnoid membrane, and palpitation of the heart. Itching of the nose, and various affections of the lips, tongue, and fauces, are frequently directly chargeable to dyspepsia, constipation and other gastro-enteric derangement. What is called sick headache affords a familiar illustration of cerebral irritation dependent upon disorder of the stomach and bowels, or of these organs and of the liver. Costiveness never fails, when long continued, to oppress the brain, and produce a sense of general *malaise*.

8. *Rectum.*—There is an intimate sympathetic connection between the bladder and the rectum; also between the urethra and the lower bowel. In dysentery, hemorrhoids and fissure of the anus, strangury and spasmodic retention of urine are by no means uncommon, and sometimes constitute a source of real suffering. The ligation of a pile not unfrequently compels the surgeon to use the catheter for drawing off the urine; and I have known the vesical irritation in such a case to continue for several days. The same affections not unfrequently produce spasmodic stricture of the urethra.

9. *Teeth.*—A very lively sympathy exists between the teeth and some of the other parts of the body; more intimate and extensive than would at first sight seem possible. Children, from the pressure of the teeth upon the gums, are extremely liable, especially during our hot summer months, to vomiting,

diarrhœa, fever, and convulsions. Arachnitis occasionally supervenes upon difficult dentition; and certain affections of the skin, as eczema and porrigo, are frequently directly traceable to its effects, and rendered obstinate, if not temporarily incurable, by its persistence. A heated and tumid state of the gums, with thirst and redness of the skin, should be promptly met by the free division of these structures; otherwise, what is originally a mere irritation of the brain, stomach, or bowels, may soon be transformed into a fatal inflammation.

A decayed tooth, even when it does not itself ache, will often cause severe pain in the face, temple, neck, throat, or ear; generally, but by no means always, on the corresponding side, doubtless because all these parts are supplied by nerves derived from the same sources. When the ear is involved, the pain is propagated along the nervous cord of the tympanum, a filament of the second branch of the fifth pair of cerebral nerves. A carious tooth occasionally creates violent pain in a sound one, though at a distance from it; and the suffering ceases the moment the offending tooth is extracted. I have known a severe attack of pleurodynia kept up by a diseased tooth; the patient was bled and purged, but relief came only with the removal of the affected stump. Enlargement of the lymphatic ganglions of the neck, ulcers of the chin, epilepsy, hysteria, dyspepsia, and various other affections, sometimes of a very obstinate and distressing character, may be produced by carious teeth. It is difficult to conceive how a diseased tooth could keep up an attack of rheumatism of the hip, and yet the possibility of such an occurrence is established by some well-authenticated cases. Dysmenorrhœa has been cured by the extraction of several of the large grinders; and writers refer to instances of intermittent fever which were relieved in a similar manner, after the fruitless employment, for several months, of bark, and other remedies. A decayed tooth has been known to produce neuralgia of the arm, which promptly vanished upon its removal.

10. *Liver.*—The sympathetic relations of the liver are at once numerous and diversified, and any disturbance in them is generally productive of irritation in a number of the more important organs, especially the stomach, bowels, brain, heart, and lungs. The skin also frequently suffers in consequence of hepatic derangement, and, conversely, the liver from disorder of the cutaneous surface. Various medicines, as well as different kinds of food, are capable of seriously disturbing the functions of this organ; and it is well known that its secretions are often materially disordered by the direct influence of anxiety or strong mental emotion. An attack of jaundice is sometimes instantaneously produced by severe fright. The timid duellist and the affrighted soldier often suffer from this kind of irritation. Hepatic abscesses not unfrequently follow upon injury of the skull and brain; and, on the other hand, disease of the liver occasionally provokes serious cerebral irritation. Dyspnœa, palpitation of the heart, nausea, flatulence, and vomiting, are common effects of disease of this viscus. Pain in the top of the right shoulder has long been recognized by physicians as a symptom of hepatitis. Violent shock is occasionally followed by total suppression of bile; and the passage of a gallstone always causes intense gastric irritation.

11. *Kidneys.*—The kidneys have important sympathetic relations with different parts of the body, manifesting themselves in various forms of irritation, some of which are easily explicable, while others are involved in impenetrable obscurity. Thus, it is easy to understand why a renal calculus should excite pain in the urethra, and a desire to urinate, simply by remembering that there is here a direct continuity of structure, the mucous membrane of the kidney being prolonged as far as the head of the penis; but it is very

difficult, if not impossible, to comprehend why a foreign body of this kind, as it descends along the ureter, should occasion retraction of the testicles, and excessive irritability of the stomach. Severe injuries, involving great shock of the system, are often followed by total suppression of urine; and, on the other hand, there are various affections in which this fluid is poured out in enormous quantity.

12. *Bladder.*—The bladder also is variously affected by disturbance of its sympathetic relations. After injuries, as compound fractures and severe operations, the organ is often incapable of contracting upon its contents, thus necessitating the employment of the catheter; its perceptive faculties are suspended, and a few days usually elapse before they are reinstated, so as to enable the patient to pass his water without assistance. Stone in the bladder causes pain and burning in the head of the penis, and retraction of the testicle. Sometimes the pain is felt in the knee, heel, and foot; and a curious case has been reported where it was seated in the arm. For a long time the professional attendants were unable to discover the cause of the suffering; but at length, the man complaining of vesical trouble, a sound was introduced, when he was found to have stone, the removal of which put at once a stop to the unpleasant symptom. A very common effect of stone in the bladder is spasm of the sphincter muscle of the anus, which is often so great as to interfere with the passage of the finger. The introduction of a bougie into the urethra occasionally induces swooning, followed by violent rigors and high fever; and cases occur, although they are not common, of severe pain being excited in the extremity of the coccyx by such an operation. In the female, a warty tumor at the orifice of the urethra will occasionally cause intense pain in the region of the bladder and kidney, with a frequent desire to urinate, and excessive scalding in passing water; in short, a train of phenomena closely resembling that produced by vesical calculus.

13. *Uterus.*—There is perhaps no class of sympathies of greater interest, in a pathological and practical point of view, than those which subsist between the uterus and the general system. It was a knowledge of this circumstance which induced Aristotle to say that the womb was an animal within an animal. The morning sickness of early pregnancy, the hysterical convulsions, the depraved appetite, the rigors which usher in labor, and the contraction of the uterus when the cold hand is suddenly applied to the abdomen, are all examples of the mysterious relations by which this organ is bound to the rest of the body. Nowhere do these effects display themselves more strikingly than between the uterus and the mammary gland. During pregnancy, the breasts begin to sympathize at an early period, as is evinced by their tender and tumid condition: and the effect which the application of the child to these organs has, soon after delivery, in causing after-pains, is familiar to every one. A knowledge of this fact has induced obstetric practitioners to take advantage of this means as a remedy for inducing contraction of the uterus in case of tardy expulsion of the placenta, or tendency to hemorrhage of this organ. The derangement of the stomach which accompanies prolapsus of the uterus, the pain and swelling of the mammary gland from menstrual irritation, the suppression of the lacteal secretion in puerperal fever, and the occurrence of carcinomatous disease of the breast at the decline of life, may be cited as additional illustrations of the intimate connection between the womb and the rest of the system.

14. *Testicle.*—An intimate sympathy exists between the testicle and the parotid gland. In mumps, or inflammation of the latter organ, it is by no means uncommon for the testicle, after the lapse of some days, to take on

portions of the body, which displays itself both in health and disease, and not unfrequently becomes a cause of irritation and inflammation. A familiar example of this internuncial action occurs in cataract. When one eye suffers from this disease, the other, at no distant period, is very apt to become affected also. Even in ordinary ophthalmia a similar liability to the extension of the morbid action is exceedingly common. The sound eye either soon takes on inflammation, or, if it be so fortunate as to escape this disease, it is sure to become the seat of such an amount of morbid sensibility as to render it utterly unfit, for the time being, for the purposes of useful vision. A percussion cap, or other foreign body, lodged in one eye, has not unfrequently been the cause of destructive inflammation in the other; and this disposition to the involvement of both organs, where one is originally exclusively affected, is nowhere more forcibly and painfully exhibited than in amaurosis. It is true it is not always easy, under these circumstances, to determine, in any given case, what share of the disease in the eye secondarily affected is due to the influence of consentaneous irritation, or to the operation of the same morbific agency which provoked the original malady; but it may reasonably be assumed, in the absence of positive information, that much, in the majority of instances, is the direct result of deranged sympathy. This liability of the eyes to participate in each other's diseases seems to be due to the intimate connection which exists between the optic nerves; and the same circumstance serves to explain the reason why the eyes are so frequently affected in organic disorders of the brain.

The eyes and nose are intimately related with each other, first through the distribution of the ophthalmic branch of the fifth pair of nerves, and secondly through the pituitary membrane, which is prolonged upwards through the lachrymal passages to form the conjunctiva. Hence it is easy to see how catarrhal affections should induce pain and redness in this membrane as it is reflected over the eyes; how snuff should excite a flow of tears; and how sudden exposure of the eyes to a strong light should cause sneezing. The connections which the frontal, infra-orbitary, and other nerves form with the filaments of the ophthalmic ganglion enable us to explain the occurrence of amaurosis in consequence of blows, wounds, and neuralgia of the face, eyebrows, forehead, and temples.

The eyes are connected with the abdominal viscera, particularly the stomach and bowels, through the medium of the branches of the sixth pair with the great sympathetic. The partial blindness, consequent upon gastro-enteric irritation, is readily accounted for in this way; and the same circumstance serves to explain the dilated state of the pupil which occasionally attends the presence of worms in the alimentary canal of children. It is probable that the pneumogastric nerves also play an important part in these sympathetic relations, otherwise it would be difficult to assign a reason for the excessive nausea and vomiting which now and then supervene upon injuries and operations of the eye, as severe blows and the depression of the cataract.

The eyes and teeth sometimes actively sympathize with each other, caries of the latter occasionally keeping up violent inflammation of the former, which promptly disappears upon the removal of the offending organ. I have several times seen the photophobia attendant upon strumous ophthalmia, speedily yield in this way, after the failure of numerous other remedies.

17. *Ears.*—A curious sympathy, noticed by all aural practitioners, exists between the ears and the respiratory apparatus, and also between the ears and the stomach. Thus, pruritus of the auditory tube sometimes provokes coughing and vomiting; and the former of these effects, it is well known, is not unfrequently caused simply by probing or sponging this passage in the removal of wax, or the extraction of a foreign body. Mr. Wilde, in refer-

ring to this phenomenon, says that it is by no means unusual, although it cannot be produced in all cases. "I never witnessed it," he continues, "in children or very young persons; it is most common in males of about middle life, and is in nowise connected with any previous disease existing in the respiratory apparatus. In some persons the slightest touch of the floor of the external auditory passage, about midway between its external outlet and the inferior attachment of the membrana tympani, will bring on violent irritation and spasmodic action in the larynx. In this case also the patient will generally tell us, upon inquiry, that he does not experience pain; but the moment we touch this very sensitive spot he feels a tickling sensation in his throat, which immediately increases to the feeling one has when 'a bit is gone astray.' What the nervous connection is which induces this has not been fully determined, but the fact is worthy of note."

Arnold has reported a case of chronic vomiting in a child, which long resisted a great variety of remedies; but which was promptly cured by the extraction of a bean from each ear, the foreign substances having been introduced during play. Mr. Toynbee states that he had had under his charge a patient who suffered under a cough which no treatment subdued, but which permanently disappeared upon the removal of a fragment of dead bone from the auditory canal.

18. *Age and Effects.*—All persons are liable to suffer from irritation; but there is, as might be supposed, great diversity in this respect, in different individuals. Thus, it is well known that persons of a nervous, irritable temperament are more prone to be affected with it than such as are of a sanguine or leucophlegmatic disposition, owing no doubt to the fact that they possess a more highly-wrought nervous system. Women suffer more frequently than men, both from local and general irritation; and some of the worst forms of reflex irritation that the practitioner meets with occur in hysterical females. Infants and children are extremely liable to the disease, the slightest cause often serving to light up the most distressing suffering. Loss of sleep, anxiety, grief, hard study, intemperance, inordinate sexual indulgence, impoverished diet, and the enervating effects of a hot climate, are all circumstances which powerfully predispose to the occurrence of irritation. The inhalation of the foul air of the dissecting-room is another well-known cause operating injuriously upon the system. If a young man who is nightly engaged, until a late hour, in the study of practical anatomy, pricks his finger, he will be much more likely to suffer severely than one from a similar wound who enters the dissecting-room only occasionally. In the one case the constitution is deteriorated by exposure, and is therefore incapable of resisting the effects of disease; in the other, on the contrary, it is healthy, and indisposed to take on morbid action.

An irritable state of the system often sadly interferes with the reparative process. Thus, the healing of a wound is sometimes suddenly arrested by an unhealthy state of the system, manifesting itself in a general exaltation of the nervous sensibility, altogether incompatible with the development of healthy blastema. An aneurism of the aorta, attended with constitutional irritability, has been known to prevent the consolidation of a fracture of the femur. These, and other similar facts, are of deep practical interest, as they are suggestive of valuable therapeutic measures.

Another very common effect of irritation, especially when extensive or seated in an important organ, is derangement of the secretions, not only of the parts more immediately affected, but of the rest of the system. Thus, irritation of the brain, however induced, is very certain to disorder the functions of the stomach, liver, and kidneys, as evinced by indigestion, a bilious

This book is the
COOPER MEDICAL
SAN FRANCISCO, CAL.

appearance of the skin, and a high-colored and scanty state of the urine. The salivary glands, too, suffer, the mouth becoming dry and viscid; the head aches, the pulse is excited, and the extremities are cold.

In concluding this rapid survey of irritation and sympathy, a few remarks may be offered on the subject of idiosyncrasy, as it closely connects itself with the discussion of these two topics.

Idiosyncrasy literally signifies a peculiarity of constitution, or a state of the general system in which certain articles, whether taken as food, drink, or medicine, produce an effect altogether different from what they are accustomed to under ordinary circumstances. Thus, lobster and other varieties of shell-fish, although they may be used with perfect impunity by most persons, are extremely prone in some individuals to induce urticaria, vomiting, and purging. A young lady, a patient of mine, married, robust, and of a florid complexion, cannot eat eggs, no matter how prepared, without being seized, almost immediately after, with vomiting. Some persons are overpowered by a particular odor, or by the sight of blood. I know a lady who has not been able, for many years, to eat watermelon without being almost instantly seized with hoarseness and soreness of the throat and mouth, attended with a burning, pricking sensation, nausea, and colicky pains. The use of watermelon-seed tea invariably produces a similar effect. Another lady, formerly a patient of mine, can never take an ordinary dose of laudanum without being copiously purged; opium affects her in a similar manner, but morphia does not. Laudanum, administered by the rectum, vomits freely and nauseates for many hours. These articles, however, always afford relief to her suffering. I am acquainted with several persons, among others a physician, in whom the inhalation or smell of ipecacuanha invariably excites a violent attack of asthma, generally lasting for two or three days. In the case of the medical practitioner, the perception of the presence of this substance is so keen that, if he be in the third story of a house on the first floor of which an ordinary dose of the article is compounded, he is instantly seized with spasmodic cough and wheezing. A gentleman, for many years a patient of mine, cannot drink a cup of green tea without being promptly and copiously purged; it usually operates on the bowels in from fifteen to twenty minutes after it is taken, bringing away thin, watery evacuations, accompanied with more or less griping; black tea produces no such effect, which he has experienced from the green from his earliest recollection. In two other cases, the use of green tea, even if taken only in small quantity, invariably acts as a powerful diuretic, causing an abundant secretion of urine, with a frequent desire to void it, for a number of hours.

I remember the case of a patient, an habitual asthmatic, thirty-five years of age, a tradesman by occupation, who cannot enter a room where feathers are without instantly experiencing an aggravation of his pulmonary affection. To provoke this effect, it is not necessary that he should see or smell the feathers; it is only necessary that they shall be near him. Led blindfold into an apartment thus furnished, he will at once be conscious of their presence, and be immediately compelled to retreat.

Idiosyncrasy not unfrequently displays itself in the operation of various medicines, affording thus useful hints to the practitioner in the selection of his remedies. There are many persons who cannot take opium in any form without being kept awake by it for hours and even days, besides suffering greatly from nausea, excessive itching, delirium, and other distressing symptoms. The most minute quantity of mercury will, in some persons, cause profuse ptyalism, while in others the article may be given in large doses and for a long time without the slightest effect of this kind, the system being absolutely proof against the action of the medicine in any of its forms and modes of exhibition. Most individuals are freely purged by a drop of croton oil, and yet we occasionally meet with an instance in which hardly any operation upon the bowels is produced by twenty times that quantity.

The above instances, which might be multiplied to an almost indefinite extent from my own experience, will serve to illustrate a class of the most singular affections, whose influence in modifying, if not in inducing disease, is eminently worthy of the attention of the practitioner.

TREATMENT OF IRRITATION.

In the treatment of irritation there are several leading indications which claim special attention. The first is to remove the exciting cause; the second, to correct the secretions; and the third, to palliate the disease, both primary and consecutive.

To remove the exciting cause of irritation is not always an easy task. In many cases, indeed, it is either wholly inappreciable, or can only be guessed at. The duty of the surgeon of course plainly is to get rid of it if he can; the ball, the calculus, the splinter of wood, the dead piece of bone, and the carious tooth, are promptly extracted. Irritating ingesta are dislodged by emetics; offending feces by purgatives; worms by anthelmintics. The mortified toe is amputated; the compressed gum lanced; the suppurating felon freely laid open. Light is excluded from the inflamed eye; noise from the suffering ear; cold from the shivering surface. In all such cases the indication is plain, and in general easily fulfilled. But it is otherwise when the cause is occult. Here the disease must be met on general principles; and the judicious practitioner will do well to look into the condition of his patient's secretions, his bowels, and his diet, which are among the most common sources of the disease.

The correction of the secretions is a matter of primary importance in every case of irritation, whether local or constitutional. The manner of doing this will necessarily depend upon the character of the suffering organ; but no practitioner will fully discharge his duty if he neglect attention to this point. The viscera whose derangements are most liable to provoke reflex irritation are the stomach, bowels, liver, and uterus, and they should, therefore, always be objects of special consideration. Not unfrequently the cause of the trouble will be found to exist in irritation of the spine, or of some particular portion of the brain, demanding local depletion and counter-irritation, with perfect tranquillity of mind and body. Whatever the cause of the disturbance may be, it will be found that purgatives can rarely be dispensed with, while in not a few cases they constitute the chief anchor of our hopes. The diet, as a general rule, should be mild and unirritant, the proportions of its nutritive principles varying with the exigencies of each particular case.

The last indication is to cure the disease, or to palliate it if it be irremediable. To point out the methods of doing this in a class of affections of so protean a character as this, would be absurd. Every case must necessarily suggest its own treatment. In ordinary instances antiphlogistics, properly so called, may usually be dispensed with, and large draughts made upon the narcotic class of remedial agents, as their direct influence is to allay pain and spasm, and induce tranquillity of the system. The choice of the particular articles must be regulated by the circumstances of the case, and will often require no little judgment and experience for its successful exercise.

CHAPTER II.

CONGESTION.

It is practically a matter of no little importance that the surgeon should be able to discriminate accurately between inflammation and congestion; or, in other and more comprehensive terms, that he should possess clear and definite ideas respecting the more essential differences between these two morbid states; for upon their correct appreciation must often depend the result of his treatment. The subject, it must be confessed, is one of no ordinary difficulty, and a careful examination of what has been written upon it will serve to convince any unprejudiced mind that there are no two points in pathology concerning which there still prevails a greater amount of confusion; for what one author considers as congestion, another with equal confidence calls inflammation, and conversely; leaving thus the young and inexperienced practitioner in painful doubt not only in respect to the nature of the disease, but, what is far worse, in regard to its proper mode of management. As the subject of inflammation will be fully discussed in the ensuing chapter, I shall limit myself here to a plain and simple exposition of some of the more important facts relative to congestion, preceded by an attempt to assign to this expression its legitimate import.

Congestion signifies an accumulation of blood in a part, the result either of some mechanical obstruction, or of some vital defect in the circulation, interfering with the onward movement of the sanguineous fluid. The word is synonymous with hyperæmia, which Andral has proposed, without any just reason, as a substitute for it. It simply denotes the existence of an abnormal quantity of blood in a part, without any of the ordinary phenomena and effects of inflammation, which, however, it generally accompanies, if indeed it does not form a necessary consequence of the increased quantity of blood sent into the suffering structures in that disease. Pathologists usually divide congestion into two varieties, denominated, respectively, the active and the passive. The first, as the name implies, is characterized by inordinate activity of the part, as is evinced by its scarlet complexion, its augmented temperature, and its functional disturbance; and soon leads, if allowed to progress, to various kinds of deposits, particularly the serous and plastic. Passive congestion, on the other hand, is distinguished by the dark color of the part, the enlarged and sluggish condition of the vessels, and the chronic march of the disease. Owing to these differences in the action and aspect of the affected structures, these two varieties of congestion are often denominated arterial and venous; terms which are ill chosen, as they have a tendency to create erroneous impressions respecting the true nature of the two lesions, for it is impossible to conceive of any case of congestion, however slight or severe, in which the disease is exclusively confined to one set of vessels.

It will thus be perceived that *active congestion* is closely allied to inflammation, although it does not, properly speaking, constitute inflammation, except in the opinion of certain pathologists, who, as it seems to me, are not very felicitous in their attempts at separating the two affections from each other, although it is evident that they strive very hard to do so. They treat of congestion as a distinct entity, and yet they do not hesitate to ascribe to it phenomena and effects which belong exclusively to inflammation, and which congestion, considered in the proper sense of that term, is utterly incapable of producing. Whenever a part, however situated in relation to the amount of blood it contains, is the seat of morbid deposits, it has passed the stage of congestion, and gone over into that of inflammation. If this be not so, then it necessarily follows that active congestion and inflammation are essentially one and the same disease, and that, consequently, it is absurd to attempt to describe them separately.

In all acute inflammations, whatever their cause or situation, active congestion is a necessary antecedent of the morbid action; one of the first links in the chain of the malady. Hence it would not be improper to say that it is part and parcel of the inflammatory process, ushering in the disease, and continuing up to the very point of effusion; or, in other words, ceasing only where effusion commences. But this is strictly true only to a certain extent; for there is in every case of inflammation a circle beyond the process of the morbid action, where the blood, playing about in eddies, has accumulated in large quantity, distending the capillaries, and destined soon to part with some of its constituents, if the disease be merged in the inflammation. A real fire is lighted up here: the part is hot, preternaturally red, and perhaps somewhat painful; nay, it may be, even a little tumid, from the dilated state of the vessels; the blood moves with unwonted force and velocity; the functional disturbance augments more and more; and presently congestion ceasing, inflammation takes its place, and goes through its allotted course. Another sign of distinction is that, in active congestion, the capillaries, although greatly crowded with blood, are more easily emptied than in inflammation: during life by pressure, and after death by injecting matter.

But active congestion is not always necessarily followed by inflammation, although prone to pass into that state if it continue even for a short time. The cause which induced it having been removed, the vessels cease to attract blood in undue quantity, and getting rid of what is redundant, speedily regain their normal caliber and function. A familiar illustration of this occurrence is afforded by the conjunctiva, when, from any transient cause, a sudden and violent rush of blood takes place to the affected part; in an instant hundreds of vessels, previously invisible, become apparent, being crowded with red blood, so as to give the surface almost a scarlet hue. Now, if we analyze these phenomena, it will be found that they depend simply upon a dilated state of the vessels of the eye and the presence of an unusual quantity of blood, containing a large number of red globules, which, in the healthy state, are either withheld from these vessels, or which are propelled along them in such small numbers as not to permit their coloring matter to become visible through their delicate walls.

Another familiar example of active congestion is furnished by what occurs in the hand when plunged into cold water, or exposed to a very low temperature. The skin soon becomes remarkably red from an unnatural afflux of blood, the parts are the seat of an unpleasant tingling sensation, and the capillaries, both arterial and venous, are exceedingly dilated; still, there is no inflammation, or any tendency to morbid deposit; the suffering structures are only irritated and preternaturally injected. Cautiously treated, the hand soon regains its natural condition; the skin recovers its former hue and sensibility, the blood ceases to accumulate, and the vessels resume their normal caliber. But it is otherwise, when the case is improperly managed; the congestion then will not only continue but it will steadily increase, and be soon merged in inflammation, or perverted action and effusion.

Now what occurs in the external parts of the body, immediately under the eye of the observer, may be supposed to happen, under similar circumstances, in the internal organs. Thus, we know that when there is a sudden repulsion of the cutaneous perspiration, the blood is extremely apt to collect in the lungs, causing active congestion of the pulmonary tissues, so often the precursor of pneumonia. Poison introduced into the stomach almost instantly induces active congestion of the mucous membrane of that organ, frequently followed, in a few hours, by the most intense and destructive inflammation. A ligature bound tightly around a limb affords a good illustration of the manner in which active congestion may be supposed to be induced in strangulation of the bowel in hernia and in intussusception.

A distinction should be made between active congestion in a part, and a determination of blood to a part. The former is always the effect of some morbific influence; the latter, on the contrary, may be the result simply of a natural cause. Thus, when the infant is applied to the breast there is an instantaneous determination of blood to the organ, so as to enable the vessels to furnish the necessary supply of milk; during menstruation, there is a marked determination of blood to the uterus, probably accompanied with more or less active congestion. In blushing there is a rush of blood to the cheek; in erection, to the penis; in anger, joy, and other emotions, to the brain. Excessive, sudden, and overwhelming determination of blood to the internal organs sometimes takes place during the cold stage of intermittent fever, especially in that variety of it to which Alibert and others have applied the term malignant. In the congestive fever, as it is termed, of the Southern States, death not unfrequently results within a few hours after the commencement of the attack, the system never reacting from the effects of the chill. Scarlet fever occasionally proves fatal in a similar manner; the surface is pale, or slightly livid, the extremities are deadly cold, and the internal organs are literally inundated with blood, determination and congestion coexisting in their worst forms.

In *passive congestion*, the morbid action is distinguished by its peculiarly sluggish character; the vessels are not only dilated, but frequently varicose, tortuous, elongated, and incapable of contracting upon their crowding contents; the discoloration is dark, venous, or purple, the circulation is tardy and languid, and there is often marked evidence of morbid deposits, especially of serum and lymph, occupying the cells of the areolar tissue.

Various causes may give rise to passive congestion. The most common are the following: 1st, inflammation; 2dly, mechanical obstruction; 3dly, debility; and 4thly, dependent position.

1st. Inflammation, in whatever form occurring, is almost always followed by a certain degree of passive congestion; the affected parts, exhausted by severe suffering, are reduced in strength and life-power; the vessels, dilated to their utmost capacity, and perhaps partially ruptured, are too feeble to contract upon their contents; the crippled structures are unusually vascular; and the slightest cause is generally sufficient to rekindle the disease. Indeed, as will be stated by and by, an organ that has been once severely inflamed is ever after extremely liable to become inflamed again; passive congestion often lasting for months and even years.

2dly. Mechanical obstruction is a prolific source of passive congestion. Examples occur almost without number, both in medical and surgical practice. I shall allude only to a few, as they will be sufficient for my purpose.

A good illustration of the effects of mechanical obstruction in producing passive congestion is seen in organic disease of the valves of the aorta, impeding the passage of the blood through the lungs. Compelled to remain here habitually in undue quantity, the pulmonary vessels soon fall into a state of passive congestion, which thus acts as a predisposing cause not only of inflammation, to which individuals so affected are extremely prone, but also of pulmonary apoplexy. Obstruction of the larger veins, as the femoral and iliac, is always followed by passive congestion in the parts below. In varicose enlargement of the veins of the leg, attended with disease of their valves, the blood has great difficulty in finding its way to the heart, and the consequence is that the distal portion of the limb is always in a state of passive congestion, with a strong tendency to inflammation, and different deposits, especially the serous and plastic. Obstruction of the artery of the leg, by fibrinous concretions, is always followed by congestion and inflammation, if not gangrene of the foot.

The structures in the neighborhood of morbid growths are generally habitually congested; hence the profuse hemorrhage which so often attends their extirpation. Their vessels being compressed by the overlapping tumor, the passage of their contents is seriously interfered with, and hence they frequently undergo a remarkable dilatation, almost amounting to a real varicosity.

3dly. Debility of a part, however induced, is a frequent source of passive congestion. Examples of this form of the affection are seen in the retina and choroid coat of the eye from over-exertion of that organ; and in various parts of the body from loss of innervation, profuse hemorrhage, or other discharges, and from the natural wear and tear of the frame. If, under these circumstances, any particular organ is more feeble or exhausted than the rest, it can scarcely fail to become the seat of passive congestion, or congestion and inflammation.

4thly. That dependent position may give rise to passive congestion is a matter of daily observation. It is in this way that inflammation of the lungs is so often induced during the progress of lingering diseases and accidents, as typhoid fever, erysipelas, and compound fractures; the disease usually beginning in the posterior portions of these organs, in the form of passive congestion, and proceeding gradually but steadily from bad to worse, until it proves fatal, a result so much the more to be dreaded on account of its insidious character. In the so-called bedsores, consequent upon long confinement in one posture, during which the pressure of the body is concentrated with peculiar force upon the sacrum, the iliac crest, and the great trochanter, similar effects are produced. There is, both in these and similar instances, in the first place a determination of blood to the most dependent portions of the body, then passive congestion, and, finally, as a natural consequence, inflammation; often followed, in the latter case, by mortification.

Passive congestion, however induced, is a frequent cause of inflammation; often of a very destructive character, the more so, because the symptoms which attend it are so indistinct, if not so completely disguised, as to prevent the early recognition of their real import. It is for these reasons that the practitioner should constantly be on the alert whenever he has anything to do with diseases and injuries involving long confinement to one particular posture, and an unusual amount of expenditure of the vital forces.

Inasmuch as congestion may be induced by such a variety of causes, it would be folly to attempt to lay down anything like a regular systematic plan of treatment; to do so, would be to encroach upon every department of pathology and practice, both medical and surgical, of which we have any knowledge. The judicious surgeon, knowing how likely the continuance of such a condition is to be followed by inflammation, or to aggravate inflammation when these two states coexist, will do all in his power to avert the evil, or to combat it when he finds that it has already taken place. The leading indication of cure, in every case of congestion, is to equalize the circulation; but to accomplish this object often demands great judgment and an amount of pathological and therapeutic knowledge such as comparatively few men possess.

CHAPTER III.

INFLAMMATION.

SECT. I.—GENERAL CONSIDERATIONS.

A THOROUGH knowledge of inflammation is indispensable to every practitioner of surgery. It should form the principal subject of his studies during his pupilage, and the main object of his professional contemplation in after-life. When it is recollected that there is hardly any disease which comes within the province of this department of science that does not originate in inflammation, or that is not more or less affected by it during its progress, the truth and force of these remarks will appear sufficiently obvious. The smallest pimple upon the nose is, in point of fact, as much an inflammation as an erysipelas that covers the face and head. An ulcer of one of the mucous follicles of the mouth does not differ, in principle, from an ulcer of one of the glands of Peyer, which are the seat of so much disease and danger in typhoid fever. Many of the maladies, vaguely called nervous, are nothing but forms of inflammation, the nature and seat of which it is often difficult, if not impossible, to determine. Their predominant symptoms are of a nervous character, and hence the diseases which they accompany are usually considered as nervous, while in reality the reverse is too frequently the case.

All accidents, whatever may be their nature or degree, are necessarily followed, if the patient survive their immediate effects, by inflammation. The little wound made in venesection, the incision left in cupping, and the bite inflicted in leeching, would never heal without the aid of this process; the parts would remain open, and be the seat of incessant bleeding, or they would become festering and putrid sores. In a word, there would be no reparation after injuries of any kind, however simple, and operative surgery, instead of bearing healing on its wings, and being a blessing to our race, would be the merest cold-blooded butchery. Thus, it will be perceived that inflammation is capable of playing, as it were, a double game in the animal economy, being at one time a cause of death, and at another a source of life. It is for this reason that it is often designated by the terms healthy and unhealthy, according as the one or the other of these states predominates.

Inflammation may be defined to be a perverted action of the capillary vessels of a part, attended with discoloration, pain, heat, swelling, and disordered function, with a tendency to effusion, deposits, or new products. In addition to these changes, there is also an altered condition of the blood and nervous fluid as an important element of the morbid process. In what inflammation essentially consists, it would be idle to inquire, since it would be just as impossible to unravel its true nature as it would be to explain the intimate character of attraction, repulsion, gravitation, or cohesion. Hence, in studying its history, all that we can do is to examine its causes, symptoms, and effects, or, more properly speaking, to institute a rigid analysis of its appreciable phenomena. If we endeavor to step beyond this, we shall, like our predecessors, lose ourselves in the mazes of conjecture and hypothesis, those quicksands upon which so many of the noblest minds of the profession have, in all ages since the origin of medicine and surgery, been wrecked and

Among the acquired predisposing causes of inflammation are, the effects of previous disease, plethora, and debility, however induced. When an organ has once labored under inflammation, it is extremely apt to suffer from it again from the most trifling causes. The part, enfeebled by the attack, does not recover completely from its effects for a long time, if ever. Hence, influences which, in the natural state, would not disturb its physiological relations, are, under such circumstances, peculiarly prone to excite disease. A good illustration of this fact is afforded in the tonsillitis of children, in whom a reproduction of the malady is almost sure to be awakened upon the slightest exposure to cold. It is not necessary here to enlarge upon plethora and debility as predisposing causes of inflammation. If these states of the system are capable of preparing it for the development of disease when they are a natural result of the organization, it may readily be supposed that they would be much more likely to produce such an effect when they are acquired, in consequence of the mode of life of the individual, or of the influence of structural lesion.

Age, sex, temperament, occupation, food, dress, exercise, climate, and season, are all so many predisposing causes of inflammation. Infancy is particularly obnoxious to enteritis, croup, and arachnitis; childhood, to affections of the skin, struma, parotitis, and tonsillitis; manhood, to pneumonitis, carditis, and diseases of the genito-urinary organs; and the decline of life, to gout and rheumatism, asthma, arteritis, and the various forms of malignant maladies.

The differences in regard to the liability of inflammation in the two *sexes* arises mainly from their anatomical peculiarities, and are much less common than is generally imagined. The function of parturition renders the female particularly liable to peritonitis, phlebitis, arachnitis, and carcinoma; while the male, from his occupation and mode of life, is more prone to cystitis, urethritis, gout, rheumatism, arteritis, hepatitis, pneumonitis, and pleuritis.

Of the influence of *temperament* as a predisposing cause of disease, too little is known to enable us to speak with any degree of certainty. The sanguine temperament, being characterized by plethora with inordinate capillary activity, disposes to inflammation of the internal organs; while the lymphatic is apt to be attended with affections of the skin, joints, serous membranes, stomach, bowels, and lymphatic ganglions.

Occupation is a powerful predisposing cause of inflammation. Persons who work much in the open air, and who are much subjected to the influence of cold and wet, are extremely liable to suffer from pneumonia, arthritis, tonsillitis, and enteritis. A sedentary life leads to chronic disorder of the alimentary canal; and, if conjoined with constant mental exertion, is liable to be followed by diseases of the brain and arachnoid membrane. Excessive exercise of an organ, as of the larynx in singing and speaking, is always a predisposing cause of inflammation.

The influence of *food* in disposing to inflammation is well known. The habitual use of stimulating articles of diet, especially when conjoined with a want of due exercise, is among the most powerful of the causes under notice. On the other hand, an impoverished diet, or a privation of nitrogenous food, by inducing a defective blood, leads to scurvy, chlorosis, typhoid fever, scrofula, and inflammation of the serous structures, terminating in dropsical effusions. Certain articles, as ergot, if employed for any length of time, or in any considerable quantity, dispose to arteritis and gangrene of the extremities. The habitual indulgence in alcoholic drinks leads to gastro-enteritis, hepatitis, and attacks of epidemic diseases, whenever such diseases are prevalent.

Dress may be an indirect cause of inflammation. It may keep the body too warm or too cold, or exert injurious compression; in either event, local throat and mouth; there is no inflammation, so far as we are able to determine, in the cellular, fibrous, and serous tissues, or in the internal organs, properly so called. In tertiary syphilis the bones, periosteum, and cartilages are particularly prone to suffer, although the disorder has a more general tendency, as there is more profound contamination of the system.

Whatever doubt, however, there may still be respecting the mode of action of the above agents, there can be none about the operation of heat and cold, which are such prolific causes of inflammation. The influence of a tropical sun, acting upon an impressible nervous system, in producing hepatitis, is well known to the practitioners of our Southern States, and to those of Africa, Asia, and the West Indies. Gastritis and enteritis, in their worst forms, are often developed in the same manner. The effect of cold feet in producing tonsillitis, croup, pleurisy, pneumonia, enteritis, cystitis, and rheumatism, is familiar to every one. In all these instances the primary impression is made through the medium of the skin, by suppressing the perspiration, and throwing the onus of the functional disorder upon some internal and remote organ, between which and the cutaneous surface there is not the least direct connection.

The blood itself is a frequent source of inflammation; sometimes, because it is overloaded with earthy salts or other irritating materials, as the poison of erysipelas, carbuncle, and various eruptive diseases; at other times, because of its impoverished condition, rendering it unfit as a supporter of life and nutrition. There is reason to believe that the latter cause lies at the foundation of many of those low and unhealthy forms of inflammation which so often eventuate in destructive ulceration of the mucous and cutaneous tissues, as well as of some of the worst forms of morbid deposits, as imperfectly vitalized lymph, albumen, and tubercle. Deficient secretion, especially of the liver, kidneys, and skin, is a frequent cause of disease, various substances being thus retained in the circulation, much to the detriment of the general economy, as well as of particular organs, perhaps already predisposed to morbid action.

From the foregoing considerations it will be perceived that inflammation may be *traumatic* or *idiopathic;* that is, produced by external injury or by constitutional causes, the latter of which are often wholly inappreciable by our senses.

Inflammation is sometimes caused by *sympathy*. Thus, the eye occasionally suffers in consequence of disorder of the stomach, the brain of derangement of the intestines, the mamma of disease of the uterus, and the testicle of lesion of the urethra. A man who has for years habitually overtaxed his digestive powers, and in the meanwhile taken hardly any exercise, will be extremely apt, in time, to perish from carbuncle or erysipelas; or, at all events, to have disease, in some form or other, of the skin, simply because these parts are intimately related to one another by similarity of structure and function. For the same reason disease of the skin is very liable to be followed by disorder of the alimentary canal.

Finally, inflammation may be caused by *metastasis*. The event is characterized by a transfer, for the most part gradual, but occasionally quite sudden, of irritation from the part originally affected to another, perhaps at a considerable distance from it, and in nowise related to it by structure or function. In inflammation of the parotid gland the testis is often involved in this way, but why it should be, neither our anatomical nor our physiological knowledge enables us to explain, as there is no traceable connection of any kind whatever between them. In rheumatism of the joints the heart often suffers; and in erysipelas of the skin the morbid action frequently leaves one part of the surface and breaks out upon another. Such occurrences, which are sometimes greatly promoted by our local applications, should always be sedulously monous erysipelas of the skin has a tendency not merely to spread over the neighboring surface, in consequence of its similarity of structure and function, but also to extend in depth, thereby involving cellular tissue, aponeurosis, muscle, and, in short, every other texture within its reach. The tissues mainly concerned in the enterprise are the vascular and connective, the peculiar structure of which renders them highly favorable for the propagation of the morbid action. An inflammation, beginning in the conjunctiva, often in its progress involves the entire eye, simply from the intimate manner in which its different tunics are superimposed upon each other. In the bowel and other mucous canals the same effect is frequently witnessed. In pneumonia, especially in the more violent forms, the disease is rarely confined to the parenchymatous substance, but is almost sure, in time, to spread to the pleura and bronchia. In orchitis, although the inflammation is primarily seated in the tubular structure of the epididymis and testicle, yet it is by no means uncommon for it to extend to the albugineous coat, and occasionally even to the vaginal. An inflammation of the synovial membrane of a joint often extends, by virtue of the same law, to the articular cartilage and the head of the bone beneath, contiguity and intimate connection favoring here, as elsewhere, the propagation of morbid action.

Thirdly, the extension may be effected through the agency of the *veins* and *lymphatics*. Of the former a good example is afforded by what occasionally happens in venesection, where, apparently from the use of a foul lancet, the inflammation is sometimes spread from the little wound in the vessel, at the bend of the arm, as high up as the right auricle of the heart; and of the latter by what takes place in chancre, where the poison, taken up by the absorbent vessels of the penis, is carried by them to the glands of the groin, where it causes a hard and painful swelling, constituting what is termed a bubo. In dissection wounds the absorbent vessels always serve as vehicles for the transmission of the peculiar poison which gives to these lesions their characteristic features. For a short period after inoculation the poison is apparently latent, when its effects show themselves by one or more red lines extending up the limb as far as the axillary glands, whence, as from a common centre, its injurious consequences are radiated over the whole system.

Of the extension of inflammation by *nervous agency*, or sympathy, a familiar example is afforded in parotitis. In this disease, which attacks chiefly young subjects, the inflammation often suddenly leaves the organ originally involved, and fastens itself upon the testicle, which is then compelled to bear the whole onus of the morbid action. Of the precise manner in which this transfer is effected we are ignorant. That it is not through any direct nervous connection is sufficiently obvious, for everybody knows that no such connection exists; hence, as the only plausible explanation left us, we must conclude that it is brought about by the operation of sympathy, although of the nature of this operation it is impossible, in the present state of the science, to form any just idea. A similar relationship exists between the mamma and uterus, the stomach and lungs, and between the stomach and brain, or, rather, between the former organ and the arachnoid membrane.

Finally, inflammation may be propagated by the *blood*. This fluid, as will afterward appear, undergoes various changes in this disease, of which the most important is an increase of fibrin and colorless globules, with a strong tendency of these substances to adhere to the sides of the vessels as they are propelled along with the general circulating mass. The blood, thus altered in its properties, leads to obstruction of the capillaries in different parts of the body, thereby establishing foci of morbid action. It is not improbable that metastatic abscess, or what is now called pyemia, is generally produced in this way; at all events, this is a more rational mode of accounting for that occurrence than the one which attributes it to the absorption of pus, or the admission of this fluid into the blood, through the agency of open-mouthed veins.

3. VARIETIES OF INFLAMMATION.

With the exception, perhaps, of the epidermis, the hair, and nails, there is no part of the human economy which is not susceptible of inflammation and its consequences. The reason why these structures are usually considered as incapable of this process is, that we are not able to demonstrate in them any bloodvessels, nerves, and lymphatics, which are the great and essential elements of organization in the more thoroughly elaborated and complex tissues. Notwithstanding this, it is extremely difficult to unite in so sweeping a conclusion, when we reflect upon the fact, of which daily observation furnishes examples, that these external coverings undergo various lesions, of form, size, color, and consistence, which can only be explained on the assumption that they are the product of inflammation, modified by the nature of the affected parts. There are other structures, as the arachnoid membrane, the cornea, and some of the cartilages, in which it is impossible to detect vessels, and yet no one would doubt for a moment, on this account, that they are incapable of disease. We should, therefore, I think, not make any exception, as it respects the possibility of the occurrence of inflammation, even in regard to the scarf-skin, the hair, and nails.

The susceptibility of a part to inflammation may be stated to be, as a general rule, in direct proportion to the amount of its vascular and nervous endowments, the importance of its functions, and the nature of its exposure. Hence it is found to be most common in the skin, cellular tissue, the mucous and serous membranes, the joints, lungs, liver, kidneys, bladder, urethra, ovaries, and uterus. The only exceptions to this law are the brain and heart, which, notwithstanding their incessant labor, the excessive delicacy of their organization, and their universal sympathetic relations, are comparatively rarely the subjects of inflammation. In the thyroid body, the salivary glands, the pancreas, the prostate, and the spleen, together with the voluntary muscles and their tendons, the nerves, vessels, fibrous membranes, and even the bones, the disease is also quite uncommon, although several of these structures are sufficiently prone to suffer from inflammation as it manifests itself in certain forms of syphilis, scrofula, and rheumatism. It is easy to know why the skin should be so frequently diseased when we reflect upon its vast extent, its wonderful vascularity and nervous endowments, its sympathy with the brain, lungs, stomach, and, in fact, almost every organ in the economy, and its constant exposure to all kinds of injurious impressions. For the same reason it is not difficult to account for the frequent occurrence of pneumonia, hepatitis, nephritis, and inflammation of some of the other viscera. The cellular tissue, although less highly organized than the skin, is yet a frequent subject of disease, growing out of the circumstance that it is the great connecting link by which the various tissues of the frame are cemented together, and also that it serves as a means of transmission of the vessels and nerves from one part to another. The functional activity alone of some of the organs affords a ready key to their liability to inflammation. Thus, the genital organs are almost exempt from disease until the age of puberty; but from that time on, when their slumbering season is over, and their fretful life begins, they are extremely prone to take on morbid action, both of a common and of a specific character.

The progress of inflammation exhibits much diversity, being at one time rapid, at another slow; hence its distinction into *acute and chronic.* An acute attack is one which runs its course swiftly, and which is characterized by well-marked symptoms, as is seen, for example, in tonsillitis consequent upon a severe cold, and where, in the space of a few days, the affected gland acquires a large bulk from vascular engorgement and interstitial deposits, attended with great local and constitutional disturbance. Force and rapidity of action are its distinguishing features. Chronic inflammation, on the contrary, is marked by comparative slowness and feebleness of action; the attendant phenomena are also less bold, although there is generally a decided tendency to effusion. It may be the sequela of an acute attack, or it may show itself as a primitive affection: that is, it may exist for a considerable period without being discovered, owing to the absence of the usual diagnostic signs. Once in this condition, it may last almost for an indefinite time, as is exemplified in certain cases of gleet, leucorrhœa, tonsillitis, osteitis, arthritis, otorrhœa, and ophthalmia.

Inflammation may be *healthy* or *unhealthy*, according as it manifests a tendency to restoration, progress, or mischief. It would be wrong to regard inflammation always in the light of a disease, since it is the means which nature must necessarily employ whenever she wishes to repair the injury which has given rise to it. It is only when the process proceeds blindly, so to speak, that it is likely to be productive of harm by overpowering the part and system. An incised wound, occurring in a sound constitution, will, if properly managed, heal promptly by union by the first intention; but if the reverse be the case, there will not only be no immediate union, but its edges will separate, and suppuration taking place, a long time may elapse before consolidation will be completed. In the one case, the action is said to be healthy, in the other unhealthy; and it will generally be found that the nature of the action is a true index of the condition of the part and system; as the latter is, so will be the former. There are of course exceptions to this law, but they are infrequent and unimportant.

There is a form of inflammation to which pathologists have applied the term *irritable*, but which in reality does not differ materially from unhealthy inflammation, just described. The best illustrations of it occur in strumous ophthalmia, in ulcers of the extremities, in rupia, and in chronic tonsillitis, bronchitis, dysentery, cystitis, urethritis, and orchitis. It seems to depend upon an exaltation of the natural sensibility of the affected structures, aggravated by an unsound state of the nervous system.

Inflammation may be *common* or *specific;* common, when it proceeds from ordinary causes; specific, when it is produced by some peculiar poison, as the matter of gonorrhœa, syphilis, or smallpox. A more important distinction is, that certain inflammations are capable of appearing only in certain tissues. Thus, erysipelas is generally a disease of the skin; in rare instances it affects the mucous membrane of the mouth and throat, and, perhaps, also the peritoneum and pelvic veins, as in lying-in females; but it never fastens itself, as a primary affection, upon the muscles, aponeuroses, nerves, arteries, bones, cartilages, or internal viscera. Gout and rheumatism have a special fancy for the joints and fibro-serous textures; secondary syphilis, for the skin and fauces; tertiary syphilis, for the bones and periosteum; scrofula, for the lymphatic ganglions; and carcinoma, for the glandular structures, as the mamma, uterus, and liver.

Finally, inflammation may be *latent.* This expression is curious, and yet full of meaning; it simply implies that the morbid action does not reveal itself by the ordinary phenomena. . Such an inflammation is always to be dreaded, because, being of a peculiarly insidious character, it is extremely apt to be overlooked. One of the best examples of this form of disease is afforded by the glands of Peyer in typhoid fever, the inflammation and ulceration of which constitute the anatomical lesions of that singular malady. Patients thus affected seldom complain of pain, or, indeed, of any other suffering directly referable to these bodies, even when the morbid action is so extensive as to lead to perforation of the bowel. Latent pneumonia is a sufficiently common disease, and abscesses of the spine and other parts of the body often make great progress before their true nature is even suspected.

4. TERMINATIONS OR EVENTS OF INFLAMMATION.

Inflammation has various modes of termination; upon strict inquiry, however, it will be found that these amount only to two, and that all the rest are merely so many states, conditions, or events of the process. This distinction is real, not imaginary, and therefore of no little practical value. Philosophically speaking, there are but two terminations of the morbid action, the one being in health, the other in the death of the part. The former may occur by delitescence and resolution; the latter, by ulceration and gangrene. All deposits, whether serous, plastic, purulent, or sanguineous; and all changes of structure, whether in the form of softening, induration, contraction, or thickening, are to be viewed simply as so many products, effects, or results of inflammation, without necessarily involving a suspension of the process itself. This indeed may still go on, sometimes even for an indefinite period, and thus produce additional changes, more serious, perhaps, in their consequences than those which attended the act in its earlier stages. In suppuration, for example, the inflammation does not generally end the moment matter forms, or as soon as the pyogenic crisis has been fairly attained; instead of this it proceeds in a modified state, accompanied by ulceration, or still further deposits. The same remarks are applicable to lymphization and even to the production of serum, the latter of which may be regarded as one of the processes employed by nature to deplete the inflamed tissues; in this, however, she generally succeeds only by degrees, as is shown by the fact that the disease often continues for a considerable length of time after the drainage has commenced. Blood, either perfectly pure, or variously combined with the secretions of the affected surface, may be poured out quite freely, and yet the morbid action continue as actively as before, as we see exemplified in dysentery and other hemorrhagic forms of inflammation. Hence there is really no such thing as a termination of inflammation in effusion of serum, deposit of fibrin, or the formation of pus. These events occurring, the morbid action may still go on, being merely modified in its character by the influence exerted upon it by the attendant secretion or the morbid product.

The *nomenclature* of inflammation has been much simplified within the last quarter of a century. As it now stands it is based essentially upon the anatomy of the affected tissue, structure, or organ, the term *itis* being merely added to the name by which the part is generally known, as sclerotitis, cystitis, laryngitis. Sometimes, however, the old expressions are retained, as quinsy for inflammation of the tonsils, ophthalmia for inflammation of the eye, and gonorrhœa for inflammation of the urethra.

SECT. II.—ACUTE INFLAMMATION.

The symptoms of inflammation naturally divide themselves into local and constitutional; or those furnished by the part and those afforded by the general system.

1. LOCAL SYMPTOMS.

The most prominent external symptoms of inflammation have long been known to practitioners. They are tersely stated by Celsus to be "rubor, calor cum tumore et dolore." This writer flourished in the first century of

Christianity, and was a contemporary of Virgil, Horace, and Ovid. His knowledge of inflammation, however, was extremely imperfect, and it was not until some time after the commencement of the present century that the subject began to be studied in its relations with the different organs and tissues of the body. Bordeu, Carmichael Smith, and Bichat, by laying the foundation of general anatomy, paved the way to a more comprehensive acquaintance with the nature and seat of morbid action, and were thus instrumental in revealing an amount of light, the beneficial effects of which can even yet be hardly foreseen. They have shown us, what might, *a priori*, have been anticipated, that the phenomena enumerated by the Roman author, as characteristic of inflammation, are liable to great and constant variations, according to the nature of the affected structure, and that the most violent morbid action may often be present, and yet nearly all of these phenomena be absent. Hence, at the present day, too much stress cannot be laid upon disordered function, inasmuch as this is frequently the only symptom that is at all appreciable, especially in inflammation of the internal organs. Modern research has shed important light upon the condition of the capillary vessels and their contents in inflammation, and has enabled us to explain much of what was before obscure and mysterious in regard to the more intimate nature of the process.

1. *Discoloration.*—The discoloration of an inflamed part varies from the slightest increase of the natural hue to the deepest purple, according to the character of the affected tissues and the intensity of the morbid action. It is always, other things being equal, most distinctly marked in those structures which are very vascular, while in such as have comparatively few vessels it is either entirely wanting, or present only in a faint degree. It is a prominent phenomenon in inflammation of the skin and mucous membranes, the cellular tissue, lungs, pleura, spleen, kidneys, and peritoneum; structures which are distinguished by their great vascularity, and by the large amount of blood which they are capable of admitting in disease. On the other hand, there is but little discoloration in inflammation, however intense, of the tendons, cartilages, bones, and fibrous envelops, the brain, nerves, heart, and voluntary muscles. In inflammation of the arachnoid membrane the only evidence of disease observable after death is effusion of serum or of serum and fibrin; all trace of vascularity is wanting, and yet the morbid action has been sufficient to destroy life.

The discoloration of inflammation often acquires a high grade in a very short time, depending upon the activity of the circulation of the affected structures. In general, however, it proceeds rather slowly, keeping steady pace with the ingravescent action; advancing from rose to red, from red to purple, or from purple to black, as when the part is about to fall into mortification. It is always most distinct at the focus of the inflammation, from which it gradually recedes until, in most cases, it is insensibly lost in the natural hue of the surrounding healthy structures. Occasionally, however, as in erysipelas of the skin, as well as in some affections of the mucous membranes, the line of demarcation is very abrupt, the diseased surface exhibiting a red and well defined circle.

The discoloration varies not merely in degree, but also in its character, thereby throwing, not unfrequently, important light upon the diagnosis of the case. Thus, it may be scarlet, as in the skin, throat, and bowels; lilac or bluish, as in the sclerotica and the fibrous envelops of the muscles; brick-colored, grayish, or brownish, as in iritis; yellowish, as in erysipelas, especially when associated with derangement of the biliary secretion; of a copper hue, as in the eruptions of secondary syphilis; purple, as in the edges of a scrofulous ulcer; livid, as in violent tonsillitis; and black, as in mortification.

These varieties of color, in these and other structures, are dependent, partly upon the organization of the affected tissues, partly upon the nature of the inflammation itself, and partly upon the amount, degree, or intensity of the morbid action.

The discoloration varies in extent, from the smallest speck, perhaps not larger than a pin's head, to a surface occupying many inches, if not several feet in diameter, as in erysipelas, where the disease sometimes involves the greater portion of the body. When this is the case, the discoloration is said to be diffuse; it is arborescent, when the vessels upon which it depends are spread out in dendritic lines; punctiform, when it occurs in the form of little dots, or points, as in some of the inflammations of the serous and mucous membranes; linear, when it presents itself in a distinct streak, as in phlebitis and angeioleucitis; and maculiform, when it assumes the appearance of a blotch or ecchymosis. In the latter case, as well as in the punctiform variety of discoloration, the morbid hue is due to an actual extravasation of blood, consequent upon a rupture of some of the capillary vessels of the part.

To be of value as a diagnostic sign of inflammation, the discoloration must be permanent, not transient; advancing and receding with the morbid action; disappearing under pressure, but reappearing the moment the pressure is taken off. The blush of shame vanishes in an instant, with the excitement that produced it; and the hectic flush upon the cheek of the consumptive merely denotes the existence of the fever which succeeds the afternoon's rigor; they are very different from the discoloration which marks the rise, progress, and termination of inflammation. Besides, the latter is usually associated with other symptoms, as heat, pain, swelling, and disordered function; phenomena sufficiently distinctive, in every case, to prevent error of diagnosis.

The immediate cause of the change of color in inflammation, is a preternatural afflux of blood. It was formerly supposed that it depended upon the formation of new vessels, but the fallacy of this opinion was long ago disproved by minute injection and microscopical observation. It is now well known that there is a class of capillaries too delicate to admit a sufficiency of red blood to render them visible in the natural state, but which, the moment they become involved in irritation or inflammation, are distended to such a degree as to show themselves in every direction, hundreds and even thousands appearing, and that frequently in an instant, where hardly any could be discerned before. We see this fact exemplified in the vessels of the conjunctiva, when a particle of foreign matter lodges upon the cornea; and what occurs here may be supposed to take place, under similar circumstances, in other structures. It is only in reparative inflammation, or in the inflammation which is necessary to rebuild parts that have been lost or destroyed, that vessels are ever formed. The process is entirely incompatible with ordinary inflammation.

2. *Pain.*—Pain, like discoloration, is one of the most constant symptoms of inflammation, usually setting in early in the disease, going on steadily increasing until the morbid action has attained its maximum, and then gradually abating, as the disease recedes, until it is insensibly lost. The subject of pain presents several points of interest, which, as they have a practical importance, should be well understood by the surgeon.

Pain varies in degree from the slightest change in the normal sensibility of the part, to the most excruciating agony, according to the nature of the affected structure, and the intensity of the morbid action. Doubtless idiosyncrasy also exerts an important influence, for it is well known that what causes pain in one individual occasions little, if any, in another. Most persons bear the application of a blister well, but I have seen some in whom the remedy, although retained only for a few hours, was productive of the most exquisite torment. Such a result can only be explained on the assumption of an idiosyncrasy, or a difference in the nervous organization of our patients. The same remark is true in regard to the effects of injury. As a general rule, the pain is greatest at the focus of the inflammation; it is usually fixed in its situation, but sometimes it darts about in different directions; is increased by pressure, motion, and posture; and rarely intermits, although it often remits, especially in the morning and the early part of the forenoon.

Much diversity obtains in regard to the character of the pain, so much so, indeed, that we may often, from this circumstance alone, form a tolerably correct idea of the seat, and even of the nature, of the inflammation. Thus, in the pleura it is sharp and lancinating; in the cellular tissue, acute and throbbing, as is exemplified in boil and carbuncle; in the liver and lungs, obtuse and heavy; in the skin, prurient, itching, or burning; in the bones, dull and gnawing, as if insects were feeding upon the part; in the urethra, scalding or burning; in the conjunctiva, gritty and itching; in the teeth, throbbing, beating, or pulsatile. When inflammation is about to terminate in mortification, the pain generally becomes hot and burning.

Pain is sometimes felt at a point more or less remote from the seat of the morbid action; hence, it does not always serve to denote its existence. In coxalgia, the earliest and most prominent symptom usually is severe pain in the knee, and it has often happened, especially in the hands of the ignorant and inexperienced practitioner, that the latter has been leeched, cupped, and blistered, when all this care should have been bestowed upon the former. In inflammation of the bladder, ureters, and kidneys, a prominent symptom is uneasiness in the head of the penis; and in hepatitis, considerable suffering is often felt in the right shoulder. It is not always easy to explain these occurrences; but, in general, they are dependent either upon continuity of structure, as in the case of the urinary passages, or upon reflex action, as in coxalgia and hepatitis.

It is worthy of note that the pain is generally much more severe when the inflammation is seated in the covering of an organ, than when it occupies its proper substance. A pleuritis is always attended with severe local distress, whereas few persons ever experience any pain in pneumonitis. In inflammation of the parenchymatous structure of the liver, great disorganization may take place, and yet the patient be entirely ignorant of the fact, as far as pain is concerned; but should the fibro-serous envelop of the organ be mainly implicated, violent suffering will be a prominent symptom. The same law holds good in inflammation even of the brain and its membranes.

It is important that the practitioner should be aware of the distinction between the pain of inflammation and the pain of spasm, since it must exert an important influence upon his therapeutic measures. It has been already seen that the former is gradual, not sudden in its attack; persistent, not intermittent; increased by motion, pressure, and posture; and, moreover, it is generally accompanied by more or less febrile disturbance, and other evidences of indisposition, plainly marking its character, to say nothing of the history of the attack, which usually furnishes important light in regard to the diagnosis of the individual case. In spasm, the pain comes on suddenly, and, after having continued for a short time, intermits, or entirely disappears, only, however, to return again, and pass through the same course; in a word, it is paroxysmal, coming suddenly, and going suddenly; relieved by pressure, and nearly always attended with eructations and rumbling noises in the bowels, supposing the case to be one of colic; there is no fever—indeed, generally no constitutional excitement of any kind—and there is also an absence of the other local symptoms of inflammation, as heat, discoloration, and intumescence.

In neuralgia the pain is sharp and lancinating, often darting through the parts with the rapidity of lightning, or like an electric shock: accompanied by a sense of soreness or aching, and generally aggravated by pressure. It is usually paroxysmal in its character, coming on perhaps once every day, lasting a few hours, and then going off gradually, or even suddenly, to reappear about the same time the following day; it is, in fact, generally an intermittent disease, with a distinct interval of freedom from pain, resembling, in this respect, an ordinary intermittent fever, and having often, like it, a miasmatic origin. The pain, moreover, is not always fixed, but is at one time here, and at another there, generally in the course of a sentient nerve.

Severe pain, especially in a nervous, irritable person, is always a formidable occurrence, as it exhausts and depresses the powers of life, and is sure, if not timeously combated, to occasion serious, if not fatal, mischief. The rule, therefore, is to arrest it promptly, and at all hazard, before the disease, of which it is a symptom, has made much progress.

A sudden disappearance of pain, unless occasioned by the use of anodynes, is generally denotive of danger, as it implies a termination of the morbid action in the death of the affected structures. The occurrence should, at all events, excite suspicion, and lead to careful investigation. An individual, for example, has been the subject of strangulated hernia; the constriction has lasted for several days, and has been characterized by severe suffering, both local and general; suddenly the pain ceases, and the patient flatters himself that he will soon be well. The surgeon, however, comes to a widely different conclusion; for the sunken features, the clammy skin, the feeble and flickering pulse, the incessant hiccough, and the trembling hand, but too plainly foreshadow the approach of death from mortification of the bowel.

Pain is not always present, even although the inflammation may be extremely violent. In typhoid fever, a disease attended with inflammation of the glands of Peyer, often terminating in extensive ulceration of these bodies, there is generally an entire absence of this symptom, from first to last, unless the case is followed by perforation of the bowel, and an escape of its contents into the peritoneal cavity. In pneumonia there is frequently no pain whatever; and the same thing is true in relation to inflammation of some of the other viscera. In scrofulous affections of the spine, particularly those forms of it known as Pott's disease and psoas abscess, pain, properly so called, is one of the rarest phenomena, especially in the earlier stages of their progress. A painless inflammation is peculiarly dangerous, inasmuch as it is very liable to be overlooked by the professional attendant, particularly by one who is in the habit of placing undue confidence in the ordinary phenomena of the disease.

How is pain produced? It has been supposed that it is caused by a development of new nerves; but that this is not so is sufficiently established by the fact that this symptom is often present, and that in a very severe degree, almost at the very commencement of the morbid action, and consequently long before it is possible for such an occurrence to take place. A more plausible opinion is that the suffering is occasioned by the compression of the nerves of the part by the dilated vessels and the effused fluids; but to render this theory complete it is necessary to go a step further, and to suppose that the various component structures of the nerves themselves are inflamed. It can hardly be imagined that these structures should escape this action even in the milder grades of inflammation, much less when the disease is fully established.

Of the intimate nature of pain nothing is known. All that observation teaches is that it is a peculiar mental perception, dependent upon a healthy state of the brain, without which it is impossible for it to occur. The individual must possess the faculty of consciousness, or he cannot take cognizance of the mischief that disease produces in the different organs and tissues of the body. We have a convincing proof of this in what occurs in apoplexy and paralysis of the lower half of the body, in which the most violent inflammation may be set up, both in the internal viscera, and in the external structures, and yet the patient be utterly insensible of its presence. The brain and nerves are crippled; hence the latter are unable to convey, and the former unable to receive, painful impressions of any kind.

Although pain is undoubtedly a great evil, yet it is extremely fortunate that it is so generally present in inflammation, since it serves to warn the patient of his danger, and often imparts to the practitioner useful information respecting the nature and seat of the morbid action. How many persons formerly perished of typhoid fever, simply because there was no pain to guide the physician to the true lesions of the disease? Doubtless this affection has existed from time immemorial, but it has only been within the last quarter of a century that we have known anything definite of its seat and character. Were pain one of its prominent symptoms, it would long ago have pointed the practitioner to the condition of the glands of Peyer.

What is termed *throbbing* is a peculiar form of pain, generally denotive of the approach of suppuration. It is, however, sometimes felt at an early stage of the morbid action, especially when it involves the fibrous, fibro-serous, and osseous tissues. It is generally dependent, in the first instance, upon an unusually crowded state of the capillary vessels, impeding the onward flow of blood, and afterwards, when the disease is more fully developed, also upon the presence of inflammatory products. Posture exerts an important influence upon its production, as is evinced in whitlow, odontalgia, and common furuncle. In the first of these affections the pain is increased a hundred fold, almost in an instant, when the hand is permitted to hang down by the side of the trunk; a decayed tooth that is free from pain in the day, while the patient is sitting up or walking about, will ache violently the moment the head touches the pillow at night; and a boil on the buttock, which will cause hardly any uneasiness when the body is recumbent, will throb violently when it is erect. These occurrences, which are easily explained by the increased determination of blood which the affected structures receive, under such circumstances, teach a valuable practical lesson in regard to the importance of position in the treatment of inflammation.

3. *Swelling.*—Swelling is seldom entirely absent in inflammation of the external parts of the body, although it may be in that of certain internal structures, however violent or extensive the morbid action. Under the latter head may be enumerated, in particular, the fibrous and serous membranes, the tendons, cartilages, bones, vessels, and nerves, along with most of the different viscera. The mucous membranes also rarely suffer in this way; the principal points where swelling is liable to occur, as a result of inflammation, are the conjunctiva, glottis, tonsils, and vulva, for the reason that these parts are largely supplied with lax cellular tissue, which, wherever it exists, is so permissive of infiltration of serous and other fluids. Hence it is that swelling is generally so conspicuous in inflammation of the subcutaneous and intermuscular filamentous substance, especially in the extremities, and even sometimes in the head, as is noticed in the more severe forms of erysipelas, where the scalp and face are occasionally puffed up to an enormous extent, frightfully disfiguring the features.

The progress of the swelling varies; in general it is gradual, commencing early in the inflammation, and going on steadily increasing until the morbid action has attained its height; even then, however, it does not always stop, but often continues until the vessels have parted with their more fluid contents, which sometimes occurs only after the disease has begun to decline.

Occasionally, however, cases are met with where the swelling is most rapid and extensive, spreading, in a short time, over an entire limb, or even over the greater portion of the body. The best examples of this occurrence are witnessed in certain injuries, as compound fractures and dislocations, phlegmonous erysipelas, and the inflammation consequent upon snake-bite.

The swelling varies in its character; thus it may be soft or hard, transient or protracted, beneficial or injurious. A soft swelling is usually denotive of serous effusion; a hard one, of a deposit of fibrin, or of the more solid elements of the blood. A transient swelling is a more desirable event than a protracted one, as it is less likely to interfere with the restoration of function. Swelling often proves beneficial, inasmuch as the effusion upon which it depends is a means of depletion employed by nature to relieve inflammatory action; it answers, in fact, the same purpose as topical bleeding. When, however, the deposit is very large, or composed essentially of solid material, immense harm may be produced by it, from the manner in which it compresses the capillary vessels and interferes with the transmission of their contents; in other words, the effusion acts obstructingly, and thus causes fatal constriction. In swelling of the conjunctiva, technically called chemosis, the matter poured out often compresses the vessels of the cornea in such a manner as to induce gangrene of this membrane; and a like result occasionally follows phlegmonous erysipelas of the limbs and scrotum. Swelling may prove injurious in another way; by acting obstructingly, as in œdema of the glottis, which may cause death by preventing the ingress of the air into the lungs. A similar effect may be produced by inordinate tumefaction of the tonsils. A swollen perineum may compress the urethra and occasion retention of urine.

The immediate cause of swelling is twofold; first, engorgement of the capillary vessels, and secondly, and mainly, effusion of serum and fibrin; to which, in the more severe forms of inflammation, may be added pus and blood, the latter of which is sometimes poured out in considerable quantity.

4. *Heat.*—An increase of heat is one of the most common effects of inflammation, and hence a valuable symptom of the disease. A good illustration of this occurrence is observed in tonsillitis, gastritis, pneumonia, and the so-called fevers, in which there is often a remarkable heat of the breath; and also in many of the external varieties of inflammation, where the change is rendered apparent both by the sense of touch and by the rapid evaporation of our applications. The scalding tear in inflammation of the eye is an evidence of the same fact.

The degree of heat, emitted in the act of inflammation, has been supposed never to exceed that of the blood in the heart and large vessels. The researches of John Hunter would seem to countenance this opinion. He operated upon a man for the radical cure of hydrocele; the temperature of the vaginal tunic immediately after the withdrawal of the fluid being 92°. The cavity was now stuffed with lint, and the next day the thermometer stood at 98¾°, thus showing an increase of six degrees and three-quarters, which must have fully equalled the heat of the blood in the heart and large vessels of the subject of the observation. In repeating the experiment subsequently upon a muscular wound in the side of a dog, and upon the vagina of an ass, irritated by a solution of bichloride of mercury, he found no difference whatever, before and after the occurrence of inflammation, in the temperature of the parts. Hence, he naturally concluded that the extrication of heat during the progress of this morbid process was either very slight, or altogether inappreciable. Observations, however, made since the time of the English philosopher, conclusively show that there is frequently, if not generally, a decided increase of temperature in the inflamed structures; and, although this increase may not render the temperature of the part equal to that of the heat of the blood in the heart, yet it is none the less real and positive. It is well known that the outskirts of the body, as the feet, hands, and ears, are habitually cooler than the trunk, head, and upper portions of the extremities, because they have naturally a more feeble circulation; hence in inflammation, although their temperature may not reach 98° of Fahrenheit, yet if there be any elevation of heat over and above what these structures enjoy in the healthy state, it is to be considered as an actual augmentation. That this will generally be found to be the fact, in all the more severe forms of inflammation, my observations, many times repeated, fully convince me. In erysipelas of the skin of the trunk, in urinous infiltration of the scrotum, in acute abscess, in tonsillitis, orchitis, bubo, and other affections, I have again and again seen the mercury rise in the instrument above 100°, and in some instances even as high as 105°, 106°, and 107°. It has been ascertained that the oviduct of a frog ready to spawn is two degrees hotter than the heart; and Professor Dunglison has seen the temperature of the uterus during labor as high as 106°. From all these facts, to which others equally convincing might be added, if space permitted, it is impossible to avoid the conclusion that there is generally an elevation of heat in inflammation, in whatever part of the body it may be situated, provided the action which accompanies it is not too slight, or too limited in extent.

Our knowledge of the nature of animal heat is hardly sufficient to justify us in expressing an opinion regarding the cause of its increase in inflammation. It may be supposed, however, in the absence of positive information, that it is due to the friction which the blood experiences in its passage through the vessels, not only in the inflamed parts, but in the system at large, and also to the rapid manner in which the oxygen of the air unites with the red particles of this fluid as it is propelled along in its turbulent course. The influence of an accelerated state of the circulation upon the production of animal heat is well exemplified in what occurs in ordinary exercise when the feet are cold. A rapid walk, under such circumstances, in the open air, soon equalizes the circulation, and sends the blood, loaded with oxygen, to every part of the body, warming and fertilizing it as it rushes on. If a horse be rode swiftly round the race track his whole body becomes immensely heated, and his blood surcharged with fibrin and colorless globules; both evidently the result of the increased friction of the blood against the coats of the vessels, and the rapid union of the oxygen of the air with that fluid. Irritating applications, as spirits of ammonia, blisters, sinapisms, and embrocations, by inviting a preternatural afflux of blood to the affected part, produce an analogous effect, accelerating the circulation, and causing an elevation of temperature. Allusion has already been made to the fact that the uterus during parturition is much hotter than it is in the natural state; a circumstance which can only be explained by the supposition of an increased activity of its vessels approximating a state similar to that which obtains in inflammation, although not identical with it. During the growth of the antler of the deer and other animals there is always a marked elevation of temperature; and phenomena of a similar kind are often witnessed during the development of malignant and other tumors. All these circumstances bear directly upon the question under consideration, if they do not positively serve to establish its truth.

5. *Functional Disorder.*—Disorder of the functions of the affected part is in general a most important symptom, being often present when all, or nearly all, the other phenomena are absent. It manifests itself in various ways, as well as in various degrees; at one time in the form of increased sensibility or irritability, at another as a suppression, alteration, or augmentation of the

natural discharge, and now as an abolition of some special sense; at one time as the slightest possible departure from the normal action of the part, and at another as a total suspension of it.

An increase of *sensibility* is one of the most common effects of inflammation. In peritonitis, gastritis, and enteritis, the sensibility of the affected structures is often so great as to render the slightest pressure of the finger a source of profound distress; and it is for the same reason that, under such circumstances, the weight even of a sheet is sometimes almost intolerable. Similar effects are noticed in some of the external diseases, as in boil, carbuncle, erysipelas, and in inflamed hemorrhoidal tumors, which are frequently the seat of the most exquisite tenderness, hardly exceeded by that which attends an inflamed eye. Parts which are devoid of feeling, or nearly so, in the sound state, as ligaments, tendons, bone, and fibrous membranes, generally become exceedingly sensitive in inflammation. The change in question is of great importance in a diagnostic point of view, inasmuch as it generally enables us to distinguish readily between inflammatory and spasmodic affections, the latter of which, as before stated, are often immensely relieved by pressure, which never fails to aggravate the former.

An increase of *irritability* is a very constant phenomenon in all inflammations of muscular parts. In cystitis, one of the earliest and most prominent symptoms is a frequent desire to urinate, arising from involvement of the muscular fibres of the bladder; in gastritis, the irritability of the stomach is often so excessive that the organ is incapable of retaining the smallest quantity of fluid, however bland; and in dysentery, the greatest distress which the patient is obliged to endure, during the progress of that dreadful malady, arises from the incessant peristaltic action of the colon and rectum, the main seats of the morbid action. An increase of the contractility of the voluntary muscles is very common in fractures and dislocations, in severe sprains, and after amputations, usually manifesting itself in spasmodic twitchings, which often require large doses of anodynes for their suppression.

Again, inflammation has the effect of diminishing, or even completely suspending, the special function of an organ. In ophthalmia, the eye cannot look at objects, however dim; the moment the effort is made the lids contract spasmodically, and the smallest ray of light that impinges upon the retina is productive of the greatest distress. In inflammation of the ear the slightest noise, which, in the healthy state would perhaps not be perceived, or which might fall as delightful music upon the tympanum, becomes a source of deep distress; and the sense of hearing is almost destroyed by the buzzing and explosive sounds which succeed the morbid action. In coryza, the sense of smell is abolished; in inflammation of the skin the patient is deprived of the sense of touch; and in glossitis there is a loss of the sense of taste. In laryngitis the voice is at first merely altered in its character, but as the disease progresses the individual often becomes completely aphonious. In cerebritis there is generally delirium, followed, if the case passes on to suppuration, by convulsions and coma, the precursors of speedy dissolution.

Another prominent symptom of inflammation, one, indeed, which is seldom absent, is disorder of the *secretions*. Thus, in inflammation of the skin, there is suppression of the perspiration; in hepatitis, of the bile; in nephritis, of the urine. Or, instead of a total arrest of these and other secretions, important changes are effected in their composition, or in their physical, chemical, and microscopical properties. In pneumonia, the characteristic symptom is a rust-colored sputum, and in dysentery, a discharge of bloody mucus.

The function of *absorption* is often seriously impeded, if not completely arrested, in inflammation. The disorder, however, is generally much more conspicuous in the advanced than in the early stages of inflammation, in which this process is sometimes executed, even with a certain degree of vigor, as is demonstrated by the facility with which morphia and other substances are carried into the system when placed upon the skin after vesication by cantharides, ammonia, or hot water. In the more violent grades of inflammation, the function is usually kept in a state of abeyance, the action of the absorbent vessels being arrested by the morbid deposits. Afterwards, however, as the disease declines, the function of absorption is gradually re-established, and then often proceeds with great vigor, rapidly removing the fluids effused during the earlier stages of the inflammation.

It is worthy of notice that while the absorbent vessels, when the inflammation is at its height, refuse to take up extraneous matter, as, for example, morphia or belladonna, and also effused fluids, they are often very busy in removing affected textures, and that even when they are of a very firm and resisting character. A familiar illustration of this occurrence is afforded in acute abscesses, the natural evacuation of which is frequently accomplished by the agency of the absorbent vessels, where the disease is most intense. In inflammation of the joints, cartilage and even bone often suffer extensively from this cause. There is no doubt that the pressure of the effused fluids always greatly influences and promotes the occurrence.

2. CONSTITUTIONAL SYMPTOMS.

Constitutional symptoms do not always attend inflammation. The morbid action may be so mild as to prevent its recognition by the system; it is strictly a local affection, and therefore causes no general resentment. But the case is very different when the disease is severe, or when, even if it is comparatively slight, it involves an important structure; then the whole frame feels its irritating effects, and evinces a strong interest in the impending struggle. The group of phenomena thus produced constitutes what is termed inflammatory, symptomatic, or sympathetic fever, and deserves consideration as expressive of the sum of suffering of each particular organ. The period which intervenes between the establishment of the inflammation and the occurrence of fever varies from a few hours to several days, depending upon the nature of the exciting cause, the condition of the patient, the intensity of the disease, and, above all, the importance of the organ attacked. Idiopathic inflammation is generally preceded by depression or a sense of lassitude and uneasiness, attended with headache, pain in the back and limbs, bad taste in the mouth, vitiated appetite, and slight chilliness, alternating with flushes of heat. Sometimes the patient is remarkably desponding, or annoyed with disagreeable dreams, and unpleasant forebodings respecting his recovery. He feels uncomfortably, both bodily and mentally, and has a disinclination to exertion. In a word, he is unwell, or in a state intermediate between health and sickness. These phenomena, which are merely the precursors of the fever, which is as yet only in a state of incubation, may be compared, not unaptly, to the fleeting clouds which precede the outbreak of a storm; they appear and vanish for a time, but finally coalescing, they assume their allotted station in the chain of morbid changes. When fully established, the fever never intermits so long as the cause which has produced it continues in operation; but it generally remits slightly in the morning, and sometimes, though rarely, twice in the twenty-four hours. The vesperal exacerbation usually sets in late in the afternoon, and persists, with but little alteration, until towards morning, when the excitement relaxes its hold, as if in need of temporary repose to meet the gradually recurring emergency. During the calm which is now present, the patient often falls into a refreshing sleep, his thirst and restlessness subside, and the skin is bedewed with a gentle perspiration. Soon, however, the smothered fire is rekindled, and of such occurrences, is wide awake; and hence he is rarely, if ever, thrown off his guard, whatever may happen.

The *countenance*, in inflammatory fever, is usually flushed, and often appears unnaturally full, as if it were slightly tumid. The eyes are reddish, suffused, and frequently intolerant of light. The skin is hot and dry, perspiration being kept in complete abeyance; and the extremities are usually so warm and uncomfortable as to be unable to bear any covering. When the excitement is excessive, the sufferer generally finds it impossible to maintain the same posture beyond a few minutes; he tosses about from side to side, and from place to place, in search of a cool spot.

The *respiratory organs* freely participate in the general disorder. The inspirations are increased in frequency, and are usually performed with a certain degree of labor; various kinds of râles are heard, and cases occur in which there are well-marked evidences of venous congestion.

The *digestive organs* always suffer in inflammation, and therefore demand careful examination. The tongue is variously affected; sometimes red and almost clean, but generally loaded, either with a whitish, yellowish, or brownish fur, contracted, and somewhat reddish at the tip and edges; nearly always dry, and easily protruded, though often a little tremulous, especially when the accession occurs in a person of nervous temperament. The taste is vitiated, or entirely arrested, the salivary secretion is suppressed, a thick, dark-colored mucus adheres to the lips, gums, and tongue, and there is a disagreeable arid feeling in the fauces and œsophagus. The thirst is intense, and can hardly be appeased by the most frequent and abundant draughts; the appetite, on the contrary, is usually destroyed, and hence the patient often loathes food, in whatever form it may be presented to him. Nausea and a sense of gastric oppression, sometimes attended with bilious vomiting, are common attendants. The bowels are generally constipated, or alternately constipated and relaxed, distended with gas, and somewhat tender under pressure; the alvine evacuations being fetid, and variously altered in color and consistence. Along with this condition of the digestive tube there is usually more or less disorder of the liver, manifesting itself in excess, deficiency, or vitiation of its secretion. Such a condition is very apt to be present in symptomatic fever consequent upon accidents and idiopathic inflammation in malarious districts. In what manner, or degree, the functions of the pancreas are affected in this disease, we are ignorant. The probability, however, is that it suffers very much in the same way as the salivary glands of the mouth, which it intimately resembles in its structure and uses.

Among the more marked changes produced by inflammation are those in the *renal secretion*. These changes relate chiefly to the quantity, color, and consistence of the fluid. In the normal state, the average quantity of urine, in the twenty-four hours, is from thirty-five to forty-two ounces; but in inflammatory fever it often does not reach one-half or even one-third this amount. Moreover, instead of being of a clear amber hue, as it naturally is, it is commonly of a deep red tint, and surcharged with an unusual quantity of extractive matter, mucus, and lithic acid; the latter of which always falls to the bottom of the receiver, in the form of brick-colored sediment. The specific gravity of the secretion is also very much increased, and the odor is often quite offensive from the presence of various kinds of animal substances. During the height of very acute inflammation, the fluid is often slightly albuminous, and even pervaded by tubular casts. The chlorides, on the contrary, are commonly remarkably diminished, especially when there is much exudation with a tendency to cell growth. The excretion of the fluid is very much as in health, though occasionally it is greatly increased in frequency. In traumatic inflammation, as after fractures, dislocations, and amputations, the bladder is occasionally so much paralyzed as to require the aid of the catheter for the expulsion of its contents.

The *muscles* are generally the seat of great discomfort in this form of fever. Already, during the stage of incubation, the patient is harassed with a sense of lassitude, stiffness, and aching or darting pains, which, gradually augmenting in severity, at length constitute a real source of suffering. The pains in the lumbar region are particularly violent; they are always worst at night, and are often so intense as to deprive the patient completely of sleep. His back feels as if it would break into pieces, as if it were being sawed in two, or as if it were bruised, and mashed, and comminuted. Not unfrequently every joint is racked with pain, and the whole body is so exquisitely sensitive as to be intolerant of the slightest motion, pressure, or manipulation. It is this distress in the muscles that causes the patient such weary and painful nights, and which induces him to exclaim in the evening, "Oh that it were morning!" and in the morning, "Oh that it were evening!"

The suffering of the *brain* is evinced by a peevish and irritable state of the mind; by loss of sleep; by disagreeable dreams; and by occasional fits of delirium. In many cases, there is more or less perversion of special sensation; as is proved by the distracting noises in the ears, the intolerance of light, the vitiated taste and smell, and the impairment of the touch.

Finally, the *assimilative* powers being in abeyance, the body becomes gradually emaciated, and the strength fails in proportion to the impoverished condition of the blood and solids.

Such is the ordinary course of events in inflammatory fever. If the morbid action does not go on too long, or if the patient has unusual powers of resistance, he may be able to weather the storm, and finally come off conqueror. The disease, and, along with it, the fever which it has produced, will now gradually subside, the occurrence being announced by a diminution of the patient's restlessness, anxiety, and thirst, by a restoration of the moisture of the skin and mouth, and, in short, by a decided improvement in the condition of all the secretions. The sleep becomes more natural and refreshing, the appetite returns, the pulse descends to its normal standard, and the mind regains its natural equilibrium. The cessation of the fever often declares itself by the occurrence, either sudden or gradual, of a profuse sweat, to which the older pathologists applied the term critical, and by a general unlocking of all the secretions. In a word, the clouds which had so long obscured the horizon are once more succeeded by sunshine; disease has vanished, and health is regaining its supremacy.

If, on the other hand, the disease progresses, a downward tendency is gradually witnessed of evil, if not fatal portent. The symptoms, losing their inflammatory type, now assume a *typhoid* character; the pulse becomes weak, soft, and frequent, beating from one hundred and thirty to one hundred and sixty in a minute; the countenance assumes a peculiar shrunken aspect, denominated hippocratic; the surface is bedewed with clammy perspiration; the extremities are inclined to be cold; the tongue is dry and covered with a brownish or blackish fur; sordes collect upon the teeth; hiccough and twitching of the tendons supervene; and there is rapid emaciation, with corresponding failure of the strength, and low muttering delirium. Recovery is still possible, although doubtful; a well-directed plan of treatment, or even nature's unassisted efforts, may be sufficient to shake off the oppressive load, and enable the part and system to triumph over the ravages of the disease.

But typhoid fever is not always a necessary consequence of the inflammatory: it may, and often does, exist as an independent affection, coming on early in the attack, perhaps almost immediately after the commencement of the morbid action, and maintaining throughout a well-marked asthenic type. The most common cause of such an event is severe shock or loss of blood,

THIS BOOK IS THE [illegible]

occurring in an unhealthy, broken state of the system, or actual blood-poisoning, from the absorption of pus, or the operation of some specific virus, as that of malignant pustule, or that generated in the dead human body, and received by inoculation in dissection. In the more severe grades of erysipelas and carbuncle, the fever soon assumes an asthenic character, whatever may have been its type in the first instance, the system being speedily overwhelmed by the depressing influence of the morbific agent.

The occurrence of typhoid symptoms early in an idiopathic, specific, or traumatic inflammation, always portends evil, as it is necessarily denotive of great and rapid waste of life-power, which neither medicine nor food can, perhaps, successfully counteract. The nervous system is deeply involved in the morbid process; the blood is gradually deprived of its plastic properties; and, nutrition being at a stand, the body soon becomes pale, emaciated, and withered. The mind is early affected, and typhomania is generally a prominent symptom throughout. The vital forces diminish more and more, the patient, engaged in constant muttering, picks at the bedclothes, has hiccough and twitchings of the tendons, and is so weak as to be unable to support himself upon his pillow. Exhaustion, in fact, is extreme, and a few hours generally suffice to close the scene.

There is another form of fever which is often seen during the progress of inflammatory affections, and to which the term *irritative* has been not inaptly applied, as it is generally met with in persons of a nervous, irritable temperament or habit of body. The best idea that can be given of it is that it bears the same relation to the nervous system that inflammatory fever, properly so termed, sustains to the vascular; that is, the fever is characterized in the one case by irritability, or excess of sensibility, and in the other by plethora, or redundancy of vascular action. We find, accordingly, that in irritative fever there is a lively perception of pain, and an unusual exaltation of sensibility, both of the part and system; the mind is peevish and fretful, easily dissatisfied, and often filled with despondency and unpleasant foreboding; the pulse is quick, jerking, small, and sometimes wiry; sleep is imperfect and disturbed by frightful dreams; the skin is hot, dry, and difficult of relaxation; the extremities are inclined to be cold; and there are frequently nervous rigors, followed by marked reaction, and great restlessness; severe suffering is generally complained of in the loins and muscles; the slightest noise and light are a source of offence; and the head is distracted with severe pain, which often assumes a neuralgic character, and thus becomes a cause of great distress.

There are some low forms of inflammation in which the attendant fever nearly always assumes this peculiar type, being present almost from first to last. A good example of it is afforded in dissection-wounds, in certain injuries of the skull and brain, in phagedenic ulceration, in hospital gangrene, in sloughing chancres and buboes, and in tertiary syphilis, in nervous debilitated subjects.

3. CHANGES OF THE BLOOD IN INFLAMMATION.

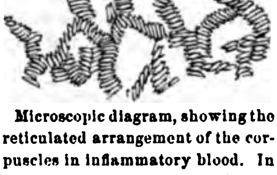
That the blood, which plays so important a part in the economy in health, should be seriously altered in its properties in inflammation is what might, *à priori*, have been anticipated, and what observation has fully established to be a fact. Sent with increased force and rapidity through every portion of the body, however constituted, or however remote from the heart; subjected to new actions and new affinities in the suffering structures, as if it were exposed to the heat of a laboratory, and deprived, in a great degree, of the stimulus of the oxygen of the air, it is not surprising that it should be almost totally changed in its physical, chemical, and vital properties. The mences to coagulate, and attains its greatest height after the process of consolidation has been completed. Its thickness and density are greatly influenced by internal and extrinsic circumstances, as the state of the system, the intensity of the disease, and the manner in which the blood is drawn. In some instances it is a mere film, while in others it forms a layer several lines in thickness; its density is also subject to considerable diversity, being at one time very feeble, and at another very firm, so much so, indeed, as to offer a good deal of resistance to the finger. When the blood is much impoverished by protracted disease, long abstinence, or unwholesome food, the buffy coat is generally very thin, soft, dirty, and iridescent, forming a striking contrast with the characters which it exhibits in plethoric states of the system.

Various extraneous circumstances materially influence the formation of the buffy coat. Of these the most important, in a practical point of view, are the shape and capacity of the receiver, the size of the stream, and the motion to which the blood is subjected in its passage from the vein. It has been ascertained that the phenomenon is most readily produced when the fluid falls into a deep and rather narrow vessel, and when it issues from a large orifice, at the rate of from two to three ounces in the minute. If the blood runs very slowly, or in a tiny stream, or, if the stream, although quite bold, is received into a cold or shallow basin, it will either not form at all, or so very imperfectly as to be scarcely appreciable. Sometimes the blood is merely sizy, the fibrin resting upon the top of the cruor like a bluish and imperfectly developed film.

Chemically considered, the buffy coat is found to consist essentially of fibrin, in combination with albumen and earthy salts. In fact, it is perfectly identical with the plastic matter that is deposited in inflammation upon the free surfaces and in the interstices of the organs. By a little care it may easily be detached from the upper surface of the crassamentum; and, if it be well washed in cold water and then immersed in alcohol, it will assume not only the peculiar buff-colored aspect, whence it derives its name, but also a dense, firm consistence, the two properties assimilating it rather closely in its physical characters to the substance of the unimpregnated uterus.

Of the manner in which the buffy coat is formed we are unable to offer any very satisfactory explanation. It was formerly supposed that it was owing to the more tardy coagulation of the blood, thereby permitting the red particles to disengage themselves from the fibrin and to sink, by their greater specific gravity, to the bottom of the crassamentum. But this was evidently a mistake; for it is now well ascertained that inflammatory blood, instead of solidifying more slowly than healthy blood, generally concretes very rapidly and firmly, thus impeding instead of favoring the development of the buffy coat. The most recent opinion upon the subject is that the occurrence is due to a vital repulsion between the fibrin and red particles; or, what amounts essentially to the same thing, to an unnatural aggregation of these bodies, which, acting like a sponge, force out the fibrin from among them before the general mass of the blood is fully coagulated. Whether this explanation is correct or not, it is certain that the formation cannot occur at all without a previous disunion of the principal constituents of the fluid, thereby predisposing them to the event in question. To ascertain whether this tendency to the development of the buffy coat exists it is not

Fig. 1.



Microscopic diagram, showing the reticulated arrangement of the corpuscles in inflammatory blood. In the upper part, normal ordinary aggregation is shown in contrast.

found, when microscopically examined, to be capable of carrying a continuous stream of blood, so as to give the part in which they are situated a red appearance. The other group includes those delicate vessels, the cavity of which is so small as to admit only a single globule at a time, and which it is often difficult to detect even with a strong magnifier.

The blood, as it circulates through the body, and immediately after it has been drawn from a vein of the arm, has the appearance of a homogeneous fluid; but a careful examination shows it to consist of numerous component elements, intended for widely different purposes in the economy. Coagulation separates it into two parts, one of which is solid, and hence called the crassamentum; the other is fluid, and named the serum. The crassamentum consists of a pale, whitish, transparent fluid, known as the blood-liquor, plastic matter, plasma, or coagulating lymph, and of minute particles, globules, or corpuscles, entangled in it and suspended by it as the blood is passing the round of the circulation. The particles are of two kinds, the red and the colorless; the former, which have long been familiar to anatomists, and which impart to the crassamentum its red hue, are exceedingly abundant, and vary in size from the $\frac{1}{3000}$ to the $\frac{1}{3500}$ of an inch in diameter; they are of a flattened, globular shape, and their office seems to be to absorb oxygen from the atmosphere and to convey it to the different parts of the system, for the purpose of invigorating its several organs and tissues. The colorless or pale corpuscles have only been recently discovered; their number is very limited, except in certain forms of disease, when it is much increased; they are round, much larger than the red, and finely granulated on the surface, thus giving them a rough appearance. What the precise office of the white corpuscles is has not been determined, but it seems probable that it is connected, in some way, with the process of nutrition, which is also the case, only more certainly, with the blood-liquor, which is essentially associated with this operation.

In the vessels of the living body, the white globules seem to have no disposition to mingle with the red; on the contrary, they keep in close contact with the inner surface of the vessels, coasting, as it were, slowly along in the blood-liquor, outside of the general current. The red particles, on the other hand, pass quietly and gently along the centre of the vessels, regardless, so to speak, of the colorless, and in a much more rapid and lively manner, without any adhesion to each other, to the white particles, or to the coats of the containing vessels.

The essential elements of the inflammatory process, so far as we are able to comprehend them, are, 1st, slight contraction of the capillaries, with a retardation of the flow of blood; 2dly, dilatation of these vessels and an increased rapidity of the circulation; and, 3dly, a quiescent state of the capillaries with complete stagnation of their contents. While these changes are going on in the interior of these vessels, important changes are wrought in the blood, both in regard to its consistence, its color, the arrangement of its globules, and the character of the plasma. Finally, the coats of the vessels are themselves seriously altered, being rendered preternaturally soft and fragile, and therefore temporarily incapable of transmitting the vital fluid. These various changes are so important as to demand for each separate consideration.

If a drop of rectified spirits, or any slight stimulus, be applied to a capillary vessel in the web of a frog's foot, or the wing of a bat, the effect will be to cause slight contraction of its caliber, with a partial arrest of its contents, the particles of blood moving to and fro for a few seconds, when they will be observed to regain their proper course, and to pass on as if nothing had occurred. If the irritation be more severe, as when a drop of tincture of capsicum is applied, the vessel, instead of diminishing, is instantly dilated, or, if there be any contraction, it is so slight and transient as to be inappreciable by the sight. However this may be, the dilatation soon becomes marked and decided, as is proved by the fact that the vessel now carries a much larger quantity of blood than in the natural state, the red particles being sent into it in increased numbers, as well as with increased force and velocity, evidently in consonance with the augmented action of the heart, which, beating perhaps from ninety to one hundred and ten in the minute, throws the blood with extraordinary impetus into the inflamed part.

The disease advancing, the dilatation of the vessels steadily and regularly augments, until, at length, its tunics having been expanded to their utmost, the artery becomes a mere passive tube, palsied and crippled in its action, and therefore not only incapacitated for transmitting its contents, but for performing any of its more delicate functions as an organ of nutrition and secretion.

In the condition now described, the capillary is not only distended to its utmost, but it is distinctly elongated and tortuous, sometimes almost knotty, as if it were affected with aneurismal enlargements, or real varices. Its coats are also preternaturally soft and lacerable, from intermolecular changes in their structure.

The blood, which is the immediate cause of this dilatation, is literally impacted in the vessel, pressing everywhere upon its sides, and thus causing, by degrees, complete remora, or stagnation. The white and red particles, instead of pursuing an orderly, quiet, and independent course, as in the natural state, are now observed to be more or less intermixed; and such is the manner in which they are crowded together, that both are materially changed in their shape, being irregularly flattened, elongated, and distorted, as well as adherent to each other and to the sides of the vessel. When there is complete stoppage, the distinction between the two sets of globules is entirely lost, the blood forming a stagnant pool, of a dark, homogeneous aspect.

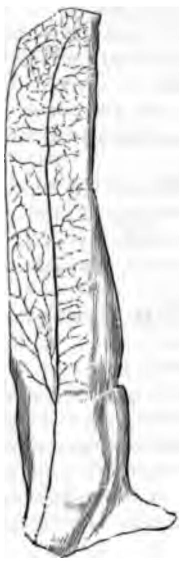
These various changes, which are brought about gradually, not suddenly, may be studied with great advantage in what occurs in inflammation of the conjunctiva. If this membrane be irritated, as, for example, by the contact of a foreign body, there will be an immediate rush of blood to the part, thus causing a great seeming increase of its vascularity. In a few minutes hundreds of vessels, previously invisible, will be seen shooting out in different directions, and connecting themselves with the sides of those that appeared in the first instance. These are not new channels, but old ones appertaining to the second class of capillaries, rendered evident by the intromission of red particles, which, in the healthy state, pass along in so slow and gradual a manner as to elude detection.

It is not to be supposed that the globules of the blood, as they are sent by the heart into the irritated arteries, are able, all at once, to pass through them without any difficulty. Instead of this, after having proceeded a certain distance, they rebound against themselves and the sides of the vessels, so as to undergo a kind of oscillatory movement; but, gradually yielding to the force exerted upon them from behind, they are urged onward and onward until they reach the corresponding veins, into which, as their caliber is much larger than that of the arteries, they rush as into a vortex, and instantly disappear in the current beyond. A similar oscillatory movement of the globules of the blood is observed when the circulation is about to be re-established after it has been completely arrested. Some time is required for the detachment of these bodies, and when they have finally succeeded in effecting this, instead of passing on at once into the corresponding vein, they are propelled forward and backward until the diseased arteries have become sufficiently dilated to admit of their escape.

The dilated condition of the vessels is well seen in the accom- nts.

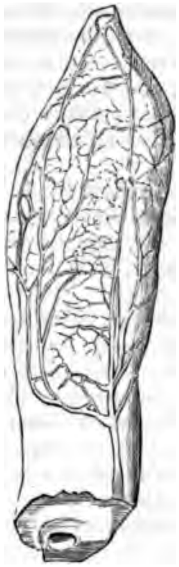
representing the two ears of a rabbit, one in the natural state, and the other in a state of inflammation, from the application of cold. They were injected simultaneously, and consequently with the same degree of force, with size colored with vermilion. Fig. 3 is the natural ear; fig. 4, the inflamed one. The contrast is striking. The vessels of the latter are not only much larger and more tortuous than in the former, but also apparently much more numerous; the main artery in the one is likewise greatly increased in size, while in the other, namely, the natural one, it is quite small.

Fig. 3.



Natural ear of a rabbit.

Fig. 4.

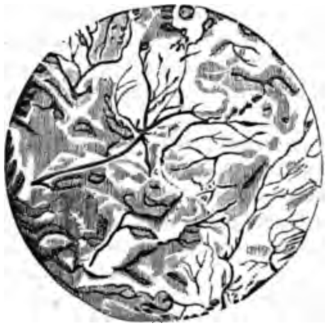


Inflamed ear of a rabbit.

But it requires no experiments upon the inferior animals to prove the existence of increased vascularity in inflammation; the remarkable change in the color of the part is sufficient evidence of the fact, to say nothing of the circumstance that, if an incision be made into it, the blood will gush out in much larger quantity than from a similar cut in the corresponding healthy structure.

When the morbid action is fully established and very intense, without, however, there being as yet complete cessation of the circulation, the contents of the affected vessels not unfrequently break through their softened and lacerable walls, occasioning thus a real extravasation of blood, as seen in fig. 5, representing a magnified portion of inflamed serous membrane. Sometimes, again, although rarely, the blood escapes from the vessels, and, forcing its way through the cellular tissue, forms new channels, through which it afterwards continues to circulate.

Fig. 5.



Extravasated blood in an inflamed serous membrane.

Immediately around the seat of the greatest intensity of the morbid action, marked congestion exists, and the blood, consequently, passes along very slowly, and with difficulty. Beyond this point the phenomena are somewhat different; the excitement is less considerable, but still sufficient to cause active vascular determination; the blood moves in a continuous stream, and with extreme velocity, but unable, as it approaches the focus of the inflammation, to make its way through the stagnant tubes, it is sent onward through collateral channels, now for the first time fairly opened for its reception. Thus it will be seen that, while at the centre of the morbid action stagnation occurs, and around this a sluggish circulation prevails, an increased activity is going on in its neighborhood. The arteries leading to the affected part are distended, and pulsate strongly, but not, as some have asserted, with preternatural frequency.

sary sequence, that inflammation, instead of being, as has sometimes been imagined, a process of perverted nutrition, is in reality merely an attempt on the part of the affected tissues to rid themselves of some hurtful impression. All the rest of the process is easily understood; the discoloration, swelling, pain, heat, and disordered function, being merely so many links in the chain of morbid action.

As the inflammation increases in intensity, the nerves actively participate in the morbid process, their substance becoming injected, softened, compressed, and otherwise altered, in conformity with the peculiarity of their structure and function. The effect of such a change upon the welfare of the affected textures must be extremely pernicious, as it must materially diminish the nervous current, if not entirely arrest it, and thus weaken and prostrate the vital powers of the part.

The joint agency of the nervous and vascular systems, in the production and maintenance of inflammation, has been happily illustrated by the researches of modern physiologists. It has been ascertained, for example, that, when the ophthalmic branch of the fifth pair of nerves is divided in the cranial cavity of a rabbit at the Varolian bridge, inflammation is speedily lighted up in the surface of the eye, eventuating in opacity of the upper segment of the cornea. What is still more remarkable is, that, when the nerve is cut on the petrous portion of the temporal bone, so as to involve the ganglion of Gasser, the resulting irritation is not only more violent, but much more deeply seated and deplorable, the consequence being complete disorganization of the organ.

Analogous effects follow the division of the pneumogastric nerves. When these cords are cut high up in the neck, the lining membrane of the air-passage assumes a dark color, the lungs are engorged with black blood, and an abundance of serosity is poured out into the parenchymatous texture, as well as into the pulmonary vesicles and the minute branches of the bronchiæ. The pleura generally participates in the irritation, and there is almost always more or less inflammation of the stomach, with a suspension of the secretion of the gastric juice.

Animals in which the brachial plexus of nerves has been tied are soon seized with inflammation of the integuments of the remote parts of the limb, which gradually progresses until all the soft structures are invaded by gangrene. A friend of mine removed a section of the peroneal nerve on account of a neuroma; the wound was long in healing, and two of the small toes sloughed before the patient recovered. These facts enable us to explain certain circumstances that have long been noticed by practitioners in particular morbid states of the system. A part affected, for instance, with palsy is much less capable of withstanding the ordinary impressions of physical agents than one receiving its customary supply of nervous influence. A burn in a paralytic person creates much more serious mischief than in one that enjoys perfect health; and the same is true in regard to blisters and other irritants, the injudicious application of which often leads to the destruction of large portions of the skin and subjacent cellular tissue. There is little doubt that the inflammation of the bladder, which always supervenes upon serious injury of the spinal marrow, is caused in the same way; that is, by the interruption of the natural supply of the nervous influence.

In whatever manner parts are deprived of their nervous influence, it is presumable that they are brought under relations somewhat analogous to those of a frozen limb. The temperature is lowered, the sensibility impaired, the process of nutrition perverted; in a word, the natural connection between the vessels and nerves is broken up, and hence that series of phenomena known under the name of inflammation.

The *tissues* at the seat of the inflammation, considered apart from the vesin the affected structures. It is only necessary to instance the arachnoid membrane, the aponeuroses, cartilages, and nerves, in which this disease is often, if not generally, unattended by a deposition of fibrin. But while it is certain that inflammation is frequently present, and that, too, to a serious extent, without fibrinous exudation, it is equally true that this substance is usually poured out in this disease, especially if it has already made considerable progress. Much will necessarily depend upon the nature of the affected organs and tissues, some furnishing plasma much more readily, and in much greater quantity, than others. Moreover, it requires very nice judgment, particularly in the living subject, to define the boundaries between congestion and inflammation, or to determine where the one terminates and the other begins. Inflammation, in its inceptive stages, may be compared to a latent or smothered fire, kept in abeyance by a redundancy of surrounding material interfering with its development; exudation cannot occur all at once, some time is necessary to prepare the vessels for their new office; so it is with the flame in the furnace, it does not break forth immediately on the application of the kindling, and yet no one would say that fire was not actually present. Most of the disputes that have grown out of this question have arisen from a misunderstanding on the part of observers as to the amount of disease, or change in the affected part, necessary to constitute inflammation; and it is obvious that there never can be any fixed or settled views upon the subject so long as this is the case; nor can the question be satisfactorily disposed of, unless it be studied with reference to the nature and functions of the different organs and tissues of the body; or, if I may use the expression, the conduct and habits of the organs and tissues in their healthy and morbid relations.

Another source of difficulty, in the settlement of this question, is the fact that many pathologists are seemingly incapable of divesting themselves of the idea that inflammation must necessarily be treated by depletion, particularly by the lancet and leeches, purgatives and starvation. It is apparently impossible for them to disconnect the two things, and yet it requires but little reflection, and certainly no great amount of experience to show the erroneousness of such a conclusion. Cases of inflammation are daily met with which imperatively demand the use of stimulants from their very commencement; and it is not going too far to assert that there is a period in almost every attack of the disease, if at all severe, in which the patient will be greatly benefited by the use of brandy, wine, quinine, and nutritious food.

Professor Virchow, of Berlin, whose cellular pathology is now attracting so much attention, asserts that inflammation is not a real entity, or a process everywhere identical in its character, as has been so often alleged, but a process essentially similar to other morbid actions, differing, in fact, from them only in its form and course. He believes that irritation is to be considered as the starting-point in inflammation; for it is impossible, he remarks, to conceive of such an occurrence without the application or intervention of some hurtful stimulus. The principal sources of this irritation are three—the functional, nutritive, and formative—the first playing, as he imagines, the least important part in the process.

"If, therefore," to use Virchow's own language, "we speak of an inflammatory stimulus, we cannot properly intend to attach any other meaning to it than that, in consequence of some cause or other external to the part which falls into a state of irritation, and acting upon it either directly, or through the medium of the blood, the composition and constitution of this part undergo alterations which at the same time change its relations to the neighboring structures, whatever may be their nature, and enable it to attract to itself and absorb from them a larger quantity of matter than usual and to transform it according to circumstances. Every form of inflammation with which we are acquainted may be naturally explained in this way. With regard to every one, it may be assumed that it begins as an inflammation from the moment that this increased absorption of matter into the tissue takes place, and the further transformation of these substances commences."

Virchow discards the idea that hyperæmia, or vascular turgescence, is present at the commencement of inflammation, alleging that, in certain parts, as the cornea, the cartilages and tendons, in which no vessels exist, the changes produced by this morbid process are in no respect different from those in the vascular structures. He also, as will be seen by and by, asserts that fibrin is not a transudation from the blood-liquor, but a direct product of the inflamed structures brought about by a change in their condition, and by the local metamorphosis of matter.

5. TREATMENT OF INFLAMMATION.

Two leading indications present themselves in every case of inflammation when sufficiently grave to demand interference. The first is the removal of the exciting cause of the disease; the second, the establishment of resolution.

In regard to the first of these points, it is obvious that, although the disease may be modified in its character, or rendered comparatively harmless, by treatment, yet it will be impossible to arrest it completely so long as the exciting cause is operative. Thus, for example, in strangulation of the bowels, it would be folly to expect to establish resolution of the inflammation which the strangulation has produced, without the removal of the stricture which is the cause of the morbid action. In such a case, one of two things must happen; either the sufferer must die from the effects of the disease, or he must be relieved by the knife, or by nature's operation, that is, the formation of an artificial anus. An inflammation of the lungs from the presence of a foreign body in the air-passages cannot be effectually cured so long as the foreign body remains, and keeps up the morbid action. The same thing is true in relation to inflammation of the bladder from hypertrophy of the prostate gland. The gland, acting obstructingly to the flow of urine, is the cause of the cystitis, and just so long as the cause remains will the disease continue, although, as remarked above, it may be materially modified by our therapeutic measures. But it does not follow, on the other hand, that the inflammation shall at once subside because the cause which produced it has been removed. The malady may have already made so much progress as to render the restoration of the part either impracticable, or possible only after a long time and after much suffering. In our attempts to get rid of the exciting cause by mechanical means, it is hardly possible to exercise too much care and gentleness, or to institute them too early. All officious interference, rude probing, or rough manipulation, must be carefully avoided, lest we add, as it were, fuel to the flame, aggravating and perpetuating the disease. Splinters, nails, needles, pieces of bone, are gently extracted with the finger and forceps; the calculus is cut out of the bladder; the speck of steel is picked from the cornea; and the aching tooth is lifted from its socket; all in as gentle and easy a manner as possible.

It is not always, however, that the exciting cause of the malady can be detected, even if we avail ourselves of all the lights furnished us by modern research. Very frequently the cause is latent, the morbid action having, to use a very common but unphilosophical expression, arisen spontaneously. Such an occurrence is, of course, impossible; there is always a cause for every disease, though it is not always in our power to discover it; and hence to wait for its removal before we begin our treatment might sadly endanger both part and patient.

The second indication is to establish resolution or to disperse the morbid action, with the least possible detriment to the structures and functions of the diseased parts. To effect this, various remedies may be necessary, some being addressed to the general system, others directly to the affected parts: circumstances which have given rise to the division of the treatment of inflammation into constitutional and local.

I. Constitutional Treatment.—The constitutional treatment of inflammation consists of bloodletting, cathartics, emetics, depressants, mercurials, diaphoretics, diuretics, anodynes, and the antiphlogistic regimen. It must not be supposed, however, that all these means, or even a majority of them, are necessary in every case of this disease; so far from this being true, the morbid action often disappears spontaneously, or under the mildest and simplest remedies. Whenever constitutional treatment is demanded, it should be employed as early as possible, and with a determined hand, in the hope of being able to arrest the inflammation while it is yet in its inception, and, consequently, before it has made any serious inroad upon the part and system. A few doses of medicine, judiciously administered at the outbreak of the disease, often do more good than twenty administered after it has attained its full development.

1. *Bleeding.*—General bleeding may justly be regarded as standing at the very head of the list of the constitutional remedies for inflammation, as it is at once the most speedy and the most efficient means of relief. The blood is usually drawn from one of the larger veins, and is permitted to flow until a decided impression has been made upon the system. When we consider the singular changes which this fluid undergoes in inflammation, the fact that it is sent in an unusually large quantity to the affected parts, and the circumstance that it is mainly instrumental in supporting the powers of the heart, it will not be difficult to form a correct idea of the importance of this operation, or the influence which it exerts in combating morbid action. Its value was not over-estimated by the older writers when they designated it as the *summum remedium* in the treatment of inflammation; yet, strange to say, bloodletting, notwithstanding the high rank which it has always occupied, as an antiphlogistic agent, has, of late, fallen very much into disrepute, particularly on this side of the Atlantic, where it had at one time so many advocates. A great change has come over the profession, in this respect, within the last fifteen years, and is steadily gaining ground, subverting all our preconceived notions upon the subject, and rendering it very questionable, in the opinion of many, whether bloodletting is really ever required as an antiphlogistic. Whether this change has been the result of a modification of the type of disease, of a more improved method of treatment with other remedies, or simply of the whim and caprice of a few prominent and influential practitioners, from whom the rest of the profession have imbibed their views, I am unable to assert, but the fact does not admit of a doubt that more quarts of blood were formerly spilt than ounces are spilt now. Bleeding is no longer the fashion; the operation is denounced by every one. Public sentiment has got to an extreme upon the subject, and we may therefore soon look for a reaction in favor of the opposite opinion. For myself, I cannot but regret this state of things, because I feel satisfied that it does not rest upon a just and proper basis. If we formerly bled too much, too frequently, too copiously, and too indiscriminately, it is equally certain, at least to my mind, that the operation is not often enough resorted to at the present day. Many a deformed limb, blind eye, enlarged spleen, and crippled lung bear testimony, in every community, to the justice of this remark.

General bleeding is employed with different views. In the first place, it diminishes plethora; secondly, it changes the qualities of the blood, or, more correctly speaking, it places it in a better condition for resisting the effects of inflammation; thirdly, it weakens the powers of the heart and nervous system, and, consequently, the momentum of the circulation; and, lastly, it promotes the action of other remedies.

To obtain these effects in the most prompt and thorough manner, the blood should be taken from a large orifice in a large vein, the fluid running in a bold, full stream to the amount of at least three ounces in the minute, the patient being either seated upon a chair or standing up at the time. If the operation is performed while the patient is recumbent, a much larger quantity will be required to be drawn before the system and part become sensible of the loss. When the object of the bleeding is merely spoliative, or intended to rob the vessels of an unusual amount of their contents, it may be done in this way; but even then the better plan will be to bleed in the semi-erect position, reopening the vein a second and even a third time, if premature syncope should take place to interfere with the requisite abstraction. The difference in the effect of these two methods of bleeding is forcibly exemplified in conjunctivitis. The patient who is bled in the erect position soon begins to feel faint, and to experience relief from pain, the eye at the same time exhibiting a blanched appearance, instead of the scarlet hue which it had a moment before; whereas the one who is bled in the recumbent position will retain his strength for a much longer time, and when, at length, he is rendered unconscious, the inflamed surface will be found to be still comparatively discolored. The impression, moreover, will generally be much more permanent in the former than in the latter, and the return, consequently, of the capillary injection more slow and less perfect.

The circumstances which call for this operation are generally considered to be a hard, strong, full, and frequent pulse, a plethoric state of the system, and great intensity of morbid action. When such a conjunction exists, the surgeon cannot possibly go amiss in regard to the abstraction of blood, constitutionally considered. He may, perhaps, it is true, combat the disease without such recourse; by the use of antimony, purgatives, and other means, he may gradually bring down inordinate excitement, and thus afford the affected structures an opportunity of throwing off the burden with which they are oppressed; but if he wishes to make a prompt and decided impression, spoliative and depressive, upon the system and part, he can accomplish his object much more readily and effectually with the lancet than with any other remedy in the whole catalogue of antiphlogistics. If nauseants depress the heart's action equally with the lancet, they certainly do not produce the same effect in unloading the engorged capillaries at the seat of the inflammation, in restoring the circulation, and in reclaiming morbid structure. The operation of the one is gradual, and, at times, almost imperceptible; of the other, prompt and decisive, often cutting down the disease with a single blow; or, at all events, leaving it in a condition to be afterwards easily dealt with by other and more simple means.

When bleeding is required, the earlier it is performed the better. Ten ounces of blood taken at the beginning of an attack of inflammation will usually do more good than four times that quantity drawn after the disease is firmly rooted. Indeed, when a part is once overburdened with deposits, the salutary period for general bleeding may be considered as passed; for, although the operation may aid in reducing the force of the heart, and in promoting the action of other remedies, yet it certainly does not exercise the same happy influence upon the capillary vessels at the seat of the disease.

The quantity of blood drawn at a single operation must vary according to circumstances, the object being effect, and not ounces; for what would be a large bleeding for one person might be a small one for another. From sixteen to twenty ounces is a good average loss. Some individuals faint almost as soon as the blood begins to flow, while others can scarcely be made to faint, no matter how they are bled, or how much blood is drawn. The best plan, therefore, always is to continue the operation until it has made a decided impression both upon the nervous and vascular systems, avoiding actual syncope, but inviting an approach to it, and then guarding against the danger of excessive reaction.

We now and then hear of enormous quantities of blood being removed for the cure of inflammation. The memoirs of the French Academy furnish us with instances where three hundred ounces were abstracted within a week; and equally remarkable examples are recorded among British writers. The late Dr. Francis, of New York, while laboring under a violent attack of croup and tonsillitis, was bled to the extent of nearly two gallons and a half in a few days. Such cases are remarkable as showing the wonderful power of endurance of the system, but they are not to be held up as examples for the imitation of the practitioner. It must be understood, however, that inflammation often engenders a tolerance of bleeding. Thus, a nervous person who in the healthy state will faint from the loss of a few ounces of blood, will, when laboring under severe inflammation, bear with impunity the loss of perhaps ten times that amount. A similar tolerance of remedies is frequently established by disease. In delirium tremens, opium may be given in doses that would destroy half a dozen healthy persons; in pneumonia, the stomach acquires an extraordinary degree of tolerance for tartar emetic: and in certain forms of syphilis mercury may be given in large quantities without salivation, the system being seemingly insusceptible of its influence.

The first effect of a loss of blood upon the system is a sense of muscular debility. Presently, the individual begins to look pale, to see indistinctly, to have a confusion of ideas, to perceive noises in his ears, and to feel light in the head. If the flow be not immediately stopped, he will next become deadly sick at the stomach, convulsive tremors will pervade his limbs, the pallor of the countenance will increase to a deadly white, the respiration and pulse will nearly cease, and, if he is not supported, he will fall down in a state of unconsciousness. He has fainted. Such an effect is sometimes produced by the loss of a drachm of blood; at other times not until many ounces have been drawn.

To recover a person from this condition, he must be immediately placed in the recumbent position, cold water dashed upon the face, and a free access of air obtained by throwing open the doors and windows of the apartment, aided, if necessary, by the fan. If he is slow in regaining his consciousness, the body is raised a little higher than the head, hartshorn is held near, not to, the nose, and sinapisms are applied to the extremities and the precordial region. Sometimes a draught of cold water will do more in reviving the patient than anything else. If, from idiosyncrasy or excessive loss of blood, the syncope assumes an alarming character, a stimulating enema is used, and mustard applied along the spine: but no stimulants are given by the mouth, unless it is certain that there is still some power of deglutition.

The reaction which succeeds the stage of depression is characterized by a gradual return of the various functions of the body to their natural condition. Color reappears upon the cheeks, the heart and lungs act with more energy, the limbs regain their warmth, the surface often becomes slightly moist, and the mind recovers from its confusion. The only treatment necessary, during this stage, is proper vigilance, lest the reaction should become too vigorous; depression being rather favored, when the morbid action is at all severe, than rapidly relieved.

When the loss of blood has been disproportionably great to the powers of the system, the stage of depression may be succeeded by death, or reaction may at length occur, the struggle for many hours, perhaps, being one of life and death. This state may be induced by one copious bleeding, or by several small ones, establishing an undue drain upon the vital current. It is characterized by unusual pallor of the countenance, feeble pulse and respiration, coldness of the extremities, clammy perspiration, frequent sighing, great thirst and restlessness, vigilance, and a tendency to delirium. While the system is in this condition, local congestion, followed by inflammation, is not uncommon, the organs which are most prone to suffer being the brain, the arachnoid membrane, and the lungs. Sometimes the symptoms here described are mixed up with those of feeble reaction, and the countenance, perhaps, is flushed, the eye and ear are intolerant of light and noise, the respiration is quickened, the skin is hot and dry, and the pulse is thready, hard, and frequent. The proper treatment does not vary essentially in the two cases, our main reliance being upon opiates in full doses, milk punch, ammonia, and quinine, with elevation of the head and cold applications, exclusion of light and noise, and blisters, if there is marked tendency to local determination. Further bleeding would only cause further sinking.

In the abstraction of blood various circumstances are to be taken into consideration, among which the most important are the age, temperament, and habit of the patient, the character and progress of the disease, the structure and functions of the affected organ, and the peculiar constitution of the atmosphere.

As a general rule, young and robust individuals bear bleeding much better than children and aged persons, who often experience great exhaustion from the loss even of a few ounces. Old subjects, in particular, are prone to suffer in this way, the system being often a long time in reacting, while in not a few instances the operation is followed by sinking. Infants and children are also slow in recovering from the effects of bleeding, but reaction having taken place there is much less danger of ultimate exhaustion. Persons of a nervous temperament are less tolerant of the loss of blood than the sanguine and bilious. Corpulent persons are bad subjects for the lancet, and the habitually intemperate are often thrown into delirium tremens by it. The inhabitants of densely crowded cities do not bear the loss of blood nearly as well as people residing in the country. In epidemics, as erysipelas, scarlatina, smallpox, measles, and puerperal fever, bleeding in any form is generally inadmissible. Finally, the abstraction of blood must be practised with the greatest circumspection in all cases of inflammation likely to be at all protracted, and in all persons suffering under grave accidents, as fractures, dislocations, and lacerated wounds, attended with danger of excessive drainage and hectic irritation. After operations and injuries, excessive loss of blood may seriously interfere with the restorative principle.

The more violent the inflammation is, the more reason will there be, other things being equal, for early and active bleeding; so also if the organ affected be one highly essential to life. Blood is seldom taken when the inflammation is inconsequential as it respects its degree and seat, milder means generally sufficing for its subjugation.

In regard to the repetition of the bleeding, the practitioner must be governed, first, by the intensity and persistence of the morbid action; secondly, by the importance of the organ attacked; and, lastly, by the state of the blood. The disease continuing with little or no mitigation, there will be the same reason for bleeding that there was in the first instance, and the last may now, perhaps, be borne much better, the previous abstraction having, it may be, engendered a certain degree of tolerance. Intensity of action will be an additional reason for the act. The importance of the organ attacked must not be overlooked. An inflamed lung requires more energetic measures than an inflamed skin, and an inflamed skin than an inflamed finger. As it respects the buffy coat of the blood, its value as a sign of the necessity of a repetition of the operation has already been pointed out, and need not, therefore, be again discussed here. Associated with a persistence of diseased action, and a vigorous state of the circulation, it is of some practical importance, but much less than was at one time supposed.

2. *Cathartics.*—Cathartics constitute a most important class of remedies in the treatment of inflammation, being even more valuable than bleeding, because of their almost universal applicability. Their exhibition, however, should always be premised by the abstraction of blood, provided the nature of the case is such as to admit of it. Where this is contra-indicated, they may be given at once, and there are few diseases which fall under the province of the surgeon in which they will not prove eminently beneficial. They are usually divided into purgatives and laxatives, which differ from each other merely in the one being more active than the other. The distinction, however, is not without its importance in a practical sense.

Cathartics, considered as antiphlogistic agents, are employed for different purposes. In the first place, they may be administered simply to evacuate the bowels; secondly, to deplete the mucous membrane, and thus diminish the quantity of blood in the system; thirdly, to excite the action of the liver and mucous follicles; fourthly, to produce a revulsive effect, or to set up a new action at a distance from the original one; and, finally, to stimulate the absorbents, thereby inducing them to remove inflammatory deposits.

The importance of exhibiting cathartics as mere evacuants cannot be too strongly insisted upon when we consider that an overloaded state of the bowels is one of the most fertile sources of disease. Many of the so-called idiopathic inflammations evidently owe their origin to this cause, as is proved by the fact that a dose of active purgative medicine often promptly removes them, especially if administered at the commencement of the attack. An incipient ophthalmia, tonsillitis, or fever, is frequently cut short in a few hours simply by clearing out the contents of the bowels, and getting rid of irritating fecal matter and vitiated secretions. Besides, as long as the bowels are constipated, it is impossible for other remedies to produce their specific effect, or for the various secretions to recover their natural tone.

Secondly, this class of remedies proves useful in depleting the bowels, by abstracting the serous portions of the blood from the vessels of the mucous membrane, and thereby diminishing the quantity of fluid in the general system. This practice is often beneficially adopted in inflammation of the large intestine, in what is termed dysentery, and in the milder forms of inflammation in various parts of the body, where the loss of the red particles of the blood is of questionable propriety. An ounce of Epsom salts, or half a pint of citrate of magnesia, will often bring away from eight to twelve ounces of serum from the bowels in the course of a few hours, with the greatest advantage as it respects the morbid action.

Cathartics may be given, in the third place, with a view to stimulate the liver, pancreas, and mucous follicles of the bowels. There are few inflammations, or diseases of any kind, in which disorder of the liver does not play a conspicuous part, either in exciting or maintaining the morbid action. The quantity of fluid poured out by this organ, in a state of health, in the twenty-four hours amounts to many ounces, and it is, therefore, not difficult to form a tolerably correct idea of the ill effects that must result from the interruption, modification, or complete suspension of its functions. The irritating material which it is destined to eliminate being retained in the blood, there must arise, as a necessary consequence, serious derangement of the nervous and vascular systems, as denoted by the excessive lassitude, headache, excited pulse, and other symptoms, so conspicuous in disordered states of the liver. But a diminished supply of bile is not the only difficulty; on the contrary, the fluid may be secreted in unnatural quantity, and yet, being vitiated in quality, the effects will hardly be less obvious. The pancreas, too, may have its functions deranged, which the well directed cathartic may readily restore to their normal condition. Of the vast influence exercised upon the health by the mucous follicles of the alimentary canal, it is hardly possible to form an adequate conception. Existing, as they do, everywhere in vast numbers upon the mucous surface, the suppression of their functions, even for a short time, cannot fail to be followed by local inflammation in different parts of the body, or the material aggravation of it, if it has been already lighted up. Hence, remedies calculated to restore, modify, or improve the secretions of these several structures constitute important objects of treatment, not only as preventives, but as means of cure.

Fourthly, the administration of cathartics proves useful in another way, namely, on the principle of revulsion, metastasis, or counter-irritation, by establishing a new action in a part more or less remote from that originally affected. During the action of a brisk purgative, as well as for some time after, a larger amount of blood flows to the alimentary canal than is natural to it, and the consequence is that the suffering organ is temporarily relieved of vascular turgescence, on the principle that two morbid processes cannot go on, to any extent, at the same time. This action may be intermittent or permanent, according to the character of the cathartic and the mode in which it is exhibited. In inflammation of the head, throat, and, in fact, of the supra-diaphragmatic portions of the body generally, this principle is never, for a moment, lost sight of by the practitioner, constituting, as it does, a most important element of treatment.

Finally, cathartics, by clearing out the alimentary canal, and restoring the secretions, pave the way for the more successful action of other remedies, as diaphoretics, anodynes, diuretics, and sorbefacients. They exert, in this respect, very much the same influence, only in a slighter degree, as venesection and leeching, diminishing the volume of the circulating mass, and diverting the blood from the suffering organ. Removing obstruction, restoring secretion, and establishing new action, they enable the absorbent vessels to recover from their torpor, and to render themselves useful in removing inflammatory deposits.

Cathartics are particularly valuable in inflammations of the brain and its membranes, of the eye and ear, the throat, respiratory organs, the liver, skin, and joints. In gastritis, enteritis, peritonitis, cystitis, wounds of the intestine, and strangulated hernia, they are either contra-indicated, or exhibited with the greatest possible circumspection, and only in the mildest forms. In most, if not in all, of these affections, the best purgative is the lancet, aided by large anodynes, either alone or in union with calomel. Tranquillity, not perturbation, is what is sought to be attained under such circumstances, on the principle that whatever excites peristaltic action must prove prejudicial to the inflamed surface.

Cathartic medicines must not be exhibited merely with a view to the correction of disordered alvine evacuation. Such a procedure could not fail to prove injurious. The action of these remedies is perturbating, and therefore subversive of healthy function; hence, it would be folly to expect that the passages should be entirely natural so long as they are exhibited. The more frequently they are given the more likely will this be the case.

When these medicines act tardily, their operation may be aided by injections; and cases occasionally occur where the latter remedies may advantageously, and entirely, take the place of the former.

The number of purgatives and laxatives is very great, and the surgeon may therefore give himself considerable latitude in the choice of his articles. A few, however, either alone, or judiciously combined, will answer his purpose in nearly every case that may come under his observation. Where a merely evacuant effect is desired, nothing is better than a dose of castor oil, rhubarb, or jalap; the saline cathartics produce watery passages; calomel, blue mass, and gray powder act specifically upon the liver; and where an irritating, revulsive, or metastatic effect is wished for, the proper articles are compound extract of colocynth, scammony, gamboge, and aloes. In external inflammations, as well as in inflammations of the supra-diaphragmatic organs generally, one of the most useful cathartics, as I have found from long experience, is an infusion of senna, or of senna and Epsom salts. It operates not only promptly and powerfully upon the bowels, but also upon the liver, stimulating this organ to increased action, and proving itself hardly inferior, in this respect, to calomel and blue mass. The only objection to it is that it is apt to gripe, but this tendency may usually be effectually counteracted by combining with it some carminative. Croton oil is rarely used, except to relieve obstinate constipation. It will hardly be necessary to say that the greatest caution is required in its administration.

Injections, clysters, or enemas may be prepared of various articles, as gruel and common salt, water and mustard, castor oil, spirits of turpentine, infusion of senna, jalap, and other substances, according to the intended effect. Whatever material be used, the important rule is to mix with it a sufficient quantity of fluid, warm or cold, to distend the lower bowel. It may be administered, as I usually prefer, with a common pewter syringe, having a long nozzle, and capable of holding at least from sixteen to twenty ounces; or, where there is obstinate constipation, with an ordinary stomach tube. Recently an excellent enema-syringe has been manufactured of gum-elastic, of the same shape as the old metallic one, only much superior in its mode of action, and much more easily kept in repair. Whatever instrument be employed, care must be taken that the patient be placed upon his side or belly during its introduction, and also that he be properly held, for fear of accident, especially if he be delirious or otherwise unmanageable. Professor Pope, of St. Louis, published, some years ago, the particulars of a case of a child that perished from perforation of the rectum during the administration of an enema.

3. *Mercury.*—The reputation of mercury, as an antiphlogistic, has long been established. Although the precise mode of its action is still imperfectly known, its beneficial effects are well understood. Its virtue in controlling inflammation is hardly inferior to that of the lancet and of tartar emetic, while, during the decline of the disease, as a powerful sorbefacient, or promoter of the removal of morbid deposits, it is without a rival in the materia medica. It may, therefore, be given during the height of the malady with a view of arresting its progress, and subsequently, after this object has been accomplished, for the purpose of getting rid of effused fluids, or reclaiming oppressed and disorganized structure. The efficacy of the remedy, in both these relations, is particularly conspicuous in the phlegmasias of the fibrous and fibro-serous tissues, in gout and rheumatism, synovitis, carditis, arteritis, hepatitis, splenitis, pneumonia, laryngitis, iritis, orchitis, osteitis, and in syphilis. It is less apparent, though not without its value, in inflammation of the brain, the skin, and mucous membranes, bronchitis, nephritis, cystitis, and metritis.

It is rarely that the treatment of inflammation is commenced with the exhibition of mercury. It is only in very urgent or neglected cases that this rule is departed from, its potency and activity being always augmented by previous depletion. Whenever, therefore, there is evidence of plethora, bleeding and purgation should precede its use. There is a mercurial point, so to speak, in inflammatory affections, prior to which the employment of this remedy either proves positively injurious, or greatly disappoints expectation. This point is characterized by softness of the pulse, a relaxed condition of the skin, moisture of the tongue, and a general tendency to restoration of the secretions. Administered during the height of the morbid action, when the whole system is enveloped, as it were, in flame, it can hardly fail to act as an irritant, and to increase the general excitement. For want of attention to this rule, a great deal of mischief is often done, and a remedy, otherwise of inestimable value, permitted to fall into disrepute.

Of the manner in which mercury acts in relieving inflammation we have, as already intimated, no very definite information. That it affords powerful aid in controlling the action of the heart and vessels, both large and capillary, is unquestionable, but how this effect is produced, whether by any direct sedative impression it may exert, or by merely correcting the secretions, is a point concerning which our knowledge is entirely at fault. Nor is our information any more reliable in regard to the changes which mercury induces in the state of the blood. We know very well how greatly the properties of this fluid are modified by inflammation, what increase there is of fibrin and white globules, and how promptly, in many cases, these changes are corrected by the judicious use of mercury; but in what manner this is effected is, in the present state of the science, altogether inexplicable. The therapeutist may speculate about these things as much as he pleases; he may invent theory after theory, and entertain us with the most elaborate and ingenious arguments, and yet he will utterly fail to throw any real and substantial light upon them. In a matter so abstruse as this experience alone can guide us, and this ought surely, for all practical purposes, to be sufficient.

During the decline of inflammation, and, indeed, in many cases long after the morbid action has been completely checked, the exhibition of mercury is of the greatest advantage in effecting riddance of the morbid products. Of the manner in which this is done we have occasionally direct ocular demonstration in some of the external phlegmasias. Thus, in iritis, if the system be placed under the influence of mercury, the effects of the remedy are rendered obvious by the daily progress which the affected structures make in freeing themselves of the plastic matter that was effused during the height of the inflammation, and which frequently proves so destructive to them by the changes which it induces in the pupil. Similar effects are witnessed in inflammation of the cornea, attended with interstitial deposits. The opacities which result from these deposits often vanish in a short time under the influence of slight ptyalism, the effect being frequently apparent before the action of the medicine is fairly developed. In orchitis, after the disease has measurably subsided, the swelling and induration in general promptly disappear under the use of mercurials, aided by rest, light diet, and purgatives. In all these, and similar cases, the beneficial effects of the agent are evidently due to its sorbefacient properties, or to the manner in which it stimulates the absorbent vessels, compelling them to remove the products left by the previous action.

Administered merely as a sorbefacient, the effects of this remedy are often insensible, its action being exerted in a very slow and gradual manner, yet hardly any the less efficiently. This kind of action is particularly desirable in chronic diseases, attended with a crippled condition of the tissues from semi-organized deposits, and an enfeebled state of the general system. Under such circumstances, active mercurialization is altogether inadmissible, from its irritating and prostrating effects; while a more gentle and persistent course is often followed by the greatest benefit, the gums being merely touched, or rendered slightly red, tumid, and tender, as an evidence of the silent operation of the remedy.

The best form of exhibition of the remedy is calomel, blue mass, or mercury with chalk. Where a prompt and powerful impression is desired, as when there is high inflammatory action, likely to prove speedily overwhelming in its effects, not only threatening structure but life, the medicine should be given in large and frequently repeated doses, so as to keep up a decided and well-sustained influence. For this purpose the best article is calomel, in doses of from three to five grains, administered every three, six, or eight hours, until we have attained the object of its exhibition. When the case is at all urgent, as, for example, in croup, pneumonia, or carditis, no time is to be lost; whatever is done must be done quickly, with a bold, vigorous hand, and a determined mind; the remedy must be given in full, not in small, insufficient quantities, or in a faltering, hesitating manner. There is but a short step between the disease and the grave, the struggle is one of life and death, and the victory must be accomplished, if accomplished at all, at all hazard, present or future. When the disease is less violent, or the organ involved less important to life, the medicine is exhibited in smaller doses, and at longer intervals, and then, too, instead of calomel, the milder forms may be used, as blue mass, or the gray powder. Where a chronic or insensible impression is desired, the bichloride may be given instead of calomel or blue mass, or the latter may be employed in smaller doses. Other forms of mercury, to be mentioned hereafter, as the iodide, cyanuret, and deutophosphate, are often beneficially prescribed in chronic disease of the skin, in glandular enlargements, in chronic affections of the joints, and in tertiary syphilis. Mercury with chalk, or gray powder, is a great favorite with some practitioners in inflammatory diseases of children and aged persons; but I now rarely use it in any case, having frequently found it to be nauseating, and generally too uncertain to be worthy of reliance.

To prevent the mercurial from running off by the bowels, it is usually necessary to combine with it a certain quantity of opium, as a fourth of a grain, half a grain or even more, with each dose, according to the exigencies of each particular case. In children, and in all cases affecting the brain, opium should be given with great caution, especially during the violence of the morbid action. When the skin is hot and dry, the mercurial should either be entirely withheld until further depletion has been accomplished, or it should be combined with some diaphoretic, as tartar emetic, ipecacuanha, or Dover's powder. Griping, which is so liable to occur during the progress of the treatment, should be counteracted by carminatives and the use of laxatives, as oil, salts, or magnesia.

It need hardly be said that the administration of so potent a remedy as mercury should be most faithfully watched. No honest or judicious practitioner uses it heedlessly or sakelessly. He knows that it is a remedy for good or for evil, and he therefore employs it wisely and properly; opportunely, not out of time. As soon as he discovers, by the fetid state of the breath, the red and tumid appearance of the gums, the metallic taste, and the increased flow of saliva, that the object of its exhibition has been attained, he either omits it altogether, or gives it only in very small quantity, and at long intervals. He does not persist in its administration, as was the custom with our silly forefathers, until the tongue is too big for the mouth, the teeth drop from their sockets, articulation, deglutition, and even breathing, are almost impossible, and the countenance presents a distorted and hideous aspect; but he simply touches the gums, maintaining the impression thus made, if necessary, on account of the continuance of the morbid action, or letting it die out, if the disease has been arrested.

There are certain individuals who, in consequence of idiosyncrasy, or the former use of mercury, cannot take this medicine, even in the smallest quantity, without being violently salivated. To avoid such an occurrence, which is always exceedingly disagreeable both to patient and practitioner, inquiry should always be made with a view to the ascertainment of this fact, in every case, previous to the administration of the medicine. On the other hand, there are persons who cannot be constitutionally impressed with mercury, however largely it may be used, under any circumstances. They are completely mercury proof. It fails to enter the system in any form, combination, or mode of exhibition. In such cases, and also when the system is not as prompt in responding to the use of the medicine as is desirable, the article should be conjoined with some nauseant, as ipecacuanha or tartar emetic, with a view to more thorough relaxation of the system. The operation of the medicine may also be aided with frictions of mercurial ointment upon the groin, the inside of the thighs, the arm, and axilla, thrice in the twenty-four hours, for fifteen minutes at a time, the inunction being performed near a fire with the hand well protected with a pair of gloves, otherwise the assistant may salivate himself long before he succeeds in affecting the patient. From one to two drachms of the ointment will suffice at each application. Employed in this way, the effect is sometimes more rapid than when the medicine is given internally, though the constitutional impression is more mild and evanescent. The practice, however, is a very filthy one, and on that account is seldom resorted to by the modern practitioner.

There are circumstances which altogether contra-indicate the use of mercurials in almost any form. Most of the horrible effects which are so often witnessed in this country, especially in the southwest, where this medicine is more liberally administered than in any other section of the United States, are, I am satisfied, entirely attributable to the reckless and indiscriminate manner in which the article is given in all states of the system, and in every possible variety of circumstance. Persons of a strumous habit of body, the old, the infirm, the ill-fed, the badly-clothed, and the anemic, are particularly prone to suffer from the use of mercury, even when exhibited only in small quantity. It is in subjects of this description, more especially, that we so frequently witness those frightful ravages of the mouth, teeth, jaws, and cheeks, that have almost led to the creation of a new department of surgery for their relief, and which have thrown so much discredit upon the profession in certain regions of the United States.

Finally, when salivation sets in, the best remedies are astringent gargles, cooling laxatives, emollient applications to the face and neck, and the liberal use of anodynes, to allay pain and nervous irritation. The lotion that I have found to answer better than any other is a solution of Goulard's extract, in the proportion of one drachm to eight ounces of water, used every hour or two, the only objection to it being that it discolors the teeth, an effect which, however, soon disappears of its own accord. Gargles of alum, tannin, copper, zinc, and other astringent substances also prove beneficial, especially if not employed too strong. When the inflammation runs very high, leeches to the throat and jaws may become necessary; and it may even be required to scarify the tongue, to prevent suffocation.

The best internal corrective of salivation is the chlorate of potassa, administered in doses of from fifteen to thirty grains three or four times a day, in a large quantity of sweetened gum-water, or lemonade, to render it more soluble. This medicine seems to act with peculiar efficacy upon the digestive organs, and may often be advantageously resorted to as a prophylactic during the exhibition of mercury. It may also be beneficially employed as a gargle, from one to two drachms being dissolved in a pint of water, and the solution used every two or three hours. In very intractable cases of ptyalism, an emetic of ipecacuanha, morning and evening, will often answer when almost everything else has failed.

4. *Emetics.*—Emetics are not as often used now as they were formerly in the treatment of inflammation, their employment having been, in great measure, superseded by cathartics and other evacuants. Their exhibition, at the present day, is limited almost exclusively to cases in which there is marked gastric and biliary derangement, as denoted by the nausea and vomiting, the headache, lassitude, and aching of the back and limbs which sometimes so greatly oppress the patient in the earlier stages of his illness. When these symptoms are present, and there is no contra-indication, an emetic often acts like a charm, not only ridding the stomach of irritating matter, but allaying vascular excitement, promoting perspiration, and, in fact, unlocking all the secretions. Emetics are, of course, not used in the phlegmasias of the sub-diaphragmatic organs, as gastritis, enteritis, peritonitis, hepatitis, and cystitis, for the reason that the concussion caused by their action would inevitably prove injurious. For the same reason they are withheld in wounds of the intestines, hernia, fractures, and dislocations. In cephalic and cardiac affections they should also be carefully avoided.

The best forms of administration are tartar emetic, and ipecacuanha; common salt, alum, and ground mustard, also occasionally answer a good purpose, their effect being generally prompt and efficient. Whatever substance be employed, its use should always be followed by large draughts of tepid water, chamomile tea, or infusion of valerian, the latter being particularly beneficial in nervous and hysterical subjects. As a general rule, tartar emetic should never be given, on account of its sedative and irritating effects, to very young children and to persons who have become enfeebled by age and disease.

5. *Depressants.*—Depressants, or nauseants, are justly entitled to a high position in the scale of antiphlogistic agents. As their name implies, they are remedies which, by lowering the action of the heart, lessen the momentum of the circulation, and diminish the flow of blood to the affected tissues. This, however, is not the only good which they are capable of doing; by the impression which they make upon the nervous and sanguiferous systems, they become instrumental in re-establishing and improving the secretions, and in thus indirectly controlling the morbid action. There is, in fact, not a single organ which does not feel, to a greater or less extent, their influence, or which is not brought, more or less, under their dominion. The effect of this operation is often witnessed during the exhibition of tartar emetic in nauseating doses, in the relaxed skin, the softened pulse, the moistened tongue, and the pallid countenance, all bearing testimony to the universal impression of the remedy. Judiciously employed, depressants are among the most valuable and efficient antiphlogistic means that we possess, and they have the advantage that they may often be used without any preliminary depletion of any kind. Their beneficial effects are particularly conspicuous in inflammation of the respiratory organs, of the eye, the joints, and fibrous structures; also in certain forms of inflammation of the skin and cellular tissue. In many of these affections, if not in all, they have almost entirely superseded the use of the lancet and other evacuants, their controlling influence over the morbid action being generally most striking and satisfactory. Their efficacy is hardly less apparent in many of the diseases of the sub-diaphragmatic viscera; but their exhibition here demands greater care and vigilance, as their emetic effects could not fail to prove prejudicial. Their employment is particularly adapted to the treatment of acute inflammation of young, robust subjects, whose systems require to be rapidly impressed in order to arrest the progress of their diseases. Infants and children, the old, infirm, and decrepit, bear their use badly, and often sink under their injudicious administration.

The most trustworthy depressants are tartar emetic and ipecacuanha, to which may be added aconite, veratrum viride, and digitalis, which, however, hold a subordinate rank. Of the depressing effects of bleeding I have already spoken, and pointed out the circumstances under which they may be most readily produced.

Tartar emetic, as a depressant, may be administered in doses varying from the eighth to the fourth of a grain, repeated every two, three, or four hours, according to their impression, which should be steadily maintained until the object of the administration of the remedy has been fully attained. It will generally be safest to begin with a small quantity, and to increase it gradually if it be found to be borne well by the stomach. Sometimes the first few doses, even if small, will produce pretty active emesis, but this, so far from being injurious, will commonly be highly beneficial, by relaxing the system and opening the emunctories. By and by, gastric tolerance will be established, and then the remedy will often be borne in extraordinary quantities, though we never employ it in the enormous doses recommended by Rasori, Thomasoni, and other disciples of the Italian school. In this country, indeed, we seldom give as much at a single dose as half a grain, the average quantity rarely exceeding one-half or one-third of that amount. The Italian practitioners, on the contrary, often gave five, ten, and even fifteen grains at a dose.

The beneficial effects of tartar emetic, as a depressant, may often be greatly enhanced by the addition to each dose of a small quantity of the salts of morphia, just enough to produce a calming and diaphoretic impression. Such a combination is particularly serviceable in nervous, irritable persons, and in subjects who have been debilitated by intemperance and other causes of exhaustion. When the article, given by itself, is productive of vomiting, it should never be used in any other way. In children, too, such a mode of exhibition is, as a general rule, indispensable. Sometimes the article may be advantageously administered along with the neutral mixture.

The dose of *ipecacuanha*, as a depressant, varies from a fourth of a grain to a grain, and may be used alone or in combination with an anodyne, as, indeed, is usually found best. A nauseant effect may be kept up in this manner almost as long as may be desired, but the impression is less pervasive and far inferior, in every respect, to that produced by tartar emetic. On this account, however, the medicine is peculiarly adapted to the treatment of inflammatory affections of children, who, as already stated, usually bear the operation of antimony very badly.

Whichever of these two articles be employed, it will be well to withhold all drinks for from fifteen minutes to half an hour after the exhibition, as, when this precaution is neglected, they are very apt to cause vomiting. At the end of this time, however, diluents, cool or tepid, may be used with the greatest benefit, from their tendency to promote relaxation and secretion.

Of *digitalis* I have not been led to form a very favorable estimate as a depressant or sedative. I was formerly in the habit of employing it a great deal in various forms and combinations, as well as in various forms and stages of inflammatory disease, and yet it would be difficult for me to recall a solitary case in which I derived any appreciable benefit from it. I have, therefore, of late years altogether abandoned its use.

Modern materia medica has gained an important accession in the addition of *aconite* as an antiphlogistic agent. The form in which it is usually exhibited is the saturated alcoholic tincture of the root, prepared according to Fleming's formula, the dose of which is from one to five drops repeated every two, three, or four hours, until it has produced its peculiar depressing effect. The best, because the safest, plan is to begin with a small quantity, and to increase it gradually and cautiously until it brings down the pulse, which, in the course of a few hours, often descends from ninety-five or one hundred to sixty-five or even fifty, the surface at the same time becoming bathed with perspiration. In large doses, it is powerfully sedative and anodyne, but it should never be given in this way on account of its prostrating influence. It is particularly adapted to neuralgic, gouty, and rheumatic affections, and to the higher grades of traumatic fever; and my practice generally is to combine it with tartar emetic and sulphate of morphia, as this insures a more prompt and beneficial action than when given by itself.

Veratrum viride is an American remedy, introduced to the notice of the profession by Dr. Osgood, of Providence. Its properties were subsequently investigated by Dr. Norwood, of South Carolina, who found it to exert a powerful influence upon the action of the heart and pulse, very similar to that of aconite, only, if possible, still more certain. The dose of the saturated alcoholic tincture of the root, the form of the medicine most generally employed, is from five to eight drops, repeated every two, three, or four hours, until it has sensibly reduced the force and frequency of the pulse, when it is either suspended or given in smaller quantity. As veratrum viride is an article of great potency, it is impossible to be too careful in its use. If carried too far, it causes nausea and vomiting, excessive prostration, faintness, vertigo, dimness of sight, and other dangerous symptoms. It is applicable to the same class of cases as aconite, and may be exhibited either by itself or in union with morphia and tartar emetic. The best means for overcoming the nauseating and depressing effects of this medicine, are opiates and alcoholic stimulants.

6. *Diaphoretics.*—Diaphoretics, in their mode of action, bear the same relation to the skin that cathartics do to the bowels. They constitute, therefore, a highly important class of remedies in inflammation, from the faculty which they possess of restoring and modifying the cutaneous perspiration, the suppression of which is a frequent source of disease. The quantity of perspiration daily thrown off by the skin, in the normal state, varies from twelve to sixteen ounces, and the retention of such an amount of material in the system must necessarily exert a most prejudicial influence upon the suffering organ. The importance of a critical sweat, as it was called by the ancient physicians, in putting a stop to disease, has long been familiar to the practitioner, and the employment of diaphoretics is only an attempt to imitate nature's efforts, in removing a cause of morbid action, or restoring a secretion which has been suppressed in consequence of the changes which that action has induced in the general system. As in the case of purgatives, depletion should always precede the employment of the remedy, so should it in the case of diaphoretics, a relaxed condition of the body always powerfully predisposing to a favorable action of the medicine.

The class of diaphoretics is very large, but there are only a few that are really at all reliable, or that are much employed by the experienced practitioner. These are tartar emetic, ipecacuanha, and Dover's powder, aided, if necessary, by tepid drinks, and sponging of the surface with tepid water. The spirit of Mindererus, in combination with a small quantity of spirit of nitric ether, makes a mild diaphoretic, and is often used in low states of the system. The efficacy of antimony, which deserves the highest rank in this class of remedies, will be greatly increased if given in union with morphine, the two articles thus counteracting the bad effects which they would produce if exhibited singly, at the same time that they subdue the heart's action, relax the skin, relieve pain, and induce sleep. The best form of exhibition is a watery solution, each dose containing from the sixth to the tenth of a grain of antimony, with from one-fourth to one-eighth of a grain of morphia, repeated every two, three, or four hours. Ipecacuanha is adapted chiefly to children and old persons, and to the latter stages of the disease, and may be given alone, or, what is preferable, with some of the salts of opium. The ordinary dose of Dover's powder, for an adult, is ten grains, but in my own practice I seldom use less than fifteen, and frequently as many as twenty, repeated every eight, ten, or twelve hours. The action of these remedies should always be aided by tepid drinks, and, if there be much dryness of the surface, by frequent sponging of the body with tepid water. During very hot weather, and in high states of inflammation, cool ablutions are often more efficient, as well as more grateful, than warm.

Bathing is not often employed in the treatment of acute inflammation, on account, chiefly, of the inconvenience and fatigue attending its use. In the chronic form of the disease, however, it is a remedy often of great value, especially in affections of the skin, joints, and abdominal viscera. The water, which may be simple or medicated, is used at various degrees of temperature, the tepid bath ranging from 85 to 92 degrees of Fahrenheit, the warm from 92 to 96, and the hot from 96 to 112. A very excellent and convenient mode of conveying moist and heated air to the patient's body, as he lies in bed, consists in attaching one end of a tin tube, from three to four feet in length, to a teakettle filled with hot water, the other end being placed under the bedclothes. Copious perspiration usually promptly follows the application, which may be maintained for any desirable period. The foot-bath is occasionally used with advantage, but to derive full benefit from it the patient should be well covered up in bed, his feet hanging in the water placed in a suitable tub upon a chair, the immersion being continued from thirty to sixty minutes. The hip-bath is employed chiefly in affections of the genito-urinary organs.

7. *Diuretics.*—Diuretics are medicines intended to restore and modify the renal secretion, which is almost invariably more or less changed in inflammatory affections. Their employment is always, as a general principle, preceded by various depletory measures, and they are never given in inflammation of the kidneys and bladder. Their administration is usually accompanied by mucilaginous drinks, but these are not at all necessary to their beneficial effects, ordinary fluids answering quite as well. They may be conveniently arranged under three distinct heads: The first includes those articles which, when received into the system, depurate the blood, and increase the quantity of solid matter of the urine, as the nitrate, acetate, and bitartrate of potassa. The second class comprises colchicum, squills, and other vegetable diuretics, which carry off the watery portions of the blood; and the third consists principally of copaiba and cubebs, which not only augment the renal secretion, but exert a peculiar influence upon the mucous membrane of the bladder and urethra, as is shown in cystitis and gonorrhœa. Of these various articles, the most important, in the treatment of acute inflammation, are nitrate of potassa and colchicum. The former may be exhibited in doses of from fifteen to thirty grains every three, four, five, or six hours, in a large quantity of water. Colchicum is generally given in the form of the vinous tincture of the seed, in doses varying from ten to fifty drops, several times in the day and night. My own practice usually is to employ one drachm along with half a grain to a grain of sulphate of morphia every evening at bedtime. In this way the medicine produces a much more decided impression upon the system, as well as upon the renal secretion, increasing its quantity, and freeing it of lithic acid, and probably, also, of other nitrogenized elements. Moreover, it usually acts upon the bowels, bringing away thin watery evacuations, especially when employed by itself; and in large quantities, it often vomits. One full dose, administered in this manner at bedtime, is far superior to three or four small ones, which often only fret and irritate the

kidneys and bowels, placing them in a condition ill calculated to correct morbid action.

8. *Anodynes.*—There is no class of remedies which require a greater amount of nice judgment and correct discrimination in respect to their selection, mode of combination, and time of administration than that of anodynes. The subject, therefore, is one that should be carefully studied with reference to these particular points, by every one desirous of acquiring correct views of the practical application of anodynes to the treatment of inflammatory affections. My conviction is that these remedies are used much less freely than they should be, and that they are capable, if properly exhibited, of affording an immense amount of benefit, not only in allaying pain and inducing sleep, but frequently also in controlling morbid action, and, consequently, in abridging its course and preventing its ravages. Want of space will not permit me to enter fully into this subject, and I shall, therefore, confine myself to a brief statement of a few of the leading facts, giving them as practical a bearing as possible.

The same rules, as respects the premising of depletory measures, are applicable to anodynes as to cathartics. Thus, first, whenever there is plethora, fecal distension, or disorder of the secretions, their correction should, if possible, precede the exhibition of the opiate. Sometimes a full dose of morphia is made to succeed a large bleeding, or an active purgative, the medicine then exercising a decidedly sedative and soothing influence. Administered before the system has been properly relaxed, it rarely fails to increase the vascular action, to lock up the secretions, produce headache, prevent sleep, and augment thirst and restlessness.

Secondly, the medicine should always be exhibited in full doses, experience having shown that it makes a much stronger, as well as a much more soothing, impression in this way than when it is taken in small, and frequently repeated doses. With the precautions pointed out, an adult will bear, when the symptoms are at all urgent, from two to four grains of opium, or its equivalent of morphia, every twelve or twenty-four hours. The effects of the remedy must be steadily watched, especially if the patient be a child, or if there be any undue cerebral excitement. Should the pulse increase in fulness and vigor under its influence, the skin become more hot and dry, or the vigilance and restlessness augment, repetition is temporarily suspended, until, by farther depletion, the system is placed in a more favorable condition for its reception.

Thirdly, the best period for the exhibition of the medicine, when there is no immediate necessity for its use, is towards bedtime, the patient being thus more likely to obtain quiet and refreshing sleep after the removal of the light and other external stimulants.

Fourthly, when there is excessive pain along with great dryness of surface, and the depletion has been already carried to a sufficient extent, the anodyne should be combined with a diaphoretic, as ipecacuanha, or, what is better, tartar emetic, or, instead of this, a full dose of Dover's powder is given.

Anodynes are particularly beneficial in all cases of inflammation attended with violent pain, which, by its persistence, might rapidly wear out the powers of life. Their value cannot be too highly appreciated in the phlegmasias of the skin and cellular tissue, the joints, the sub-diaphragmatic viscera, the eye, ear, pleura, heart, and respiratory organs. Within the last few years enormous doses of opium have been given by Professor Clark and others in peritonitis with the most happy results, and I am sure that the same mode of treatment might be advantageously extended to inflammation of many of the other parts of the body. The importance of absolute rest to the affected organ is universally conceded, and is daily witnessed in the management of external inflammation. Instinct alone is often sufficient to secure it, but where this fails the surgeon endeavors to procure it by means of various mechanical appliances. In the internal phlegmasias no such means are applicable, but here the object may be readily attained by opiates, given in full and sustained doses to control the movements of the suffering structures. In gastritis nothing so promptly and effectually quiets the muscular fibres of the stomach as a suitable quantity of morphine, and the same treatment has long been successfully employed in dysentery, or inflammation of the lower bowel. In cystitis nothing affords relief so speedily and permanently as a full anodyne. In pleuritis and pneumonia, how is it possible to give rest to the lungs and respiratory muscles, except by the same means? The more quietly the parts are kept while laboring under disease, the sooner, other things being equal, will the patient recover from its effects, and the less pain he will have to endure from the constant and rude contact of the affected surfaces upon each other. Even in inflammation of the brain and its meninges, after proper depletion has been practised, anodynes are frequently indispensable, not only to allay pain and induce sleep, but to control the morbid action. And how do they do this? Simply, in the first place, by subduing the action of the heart, and thus preventing it from sending out to the brain its accustomed quantity of blood; and, secondly, by making a direct impression upon the brain itself, thereby, in some degree, controlling its movements, so injurious both to its own substance and to its coverings, when thus affected. Anodynes, in most of these cases, as well as in many others, literally constitute nature's splint.

The best anodynes are opium and its different preparations, as the salts of morphia and laudanum. These may be given either by the mouth or rectum, double the quantity being usually required to produce the same effect in the latter as in the former case. Sometimes the remedy is employed endermically or subcutaneously, in the form of injection. There are some persons who cannot bear opium in any form. When this is the case a substitute should be sought in lupuline, hyoscyamus, Indian hemp, and other kindred articles; or, in what I have generally found to answer very well under such circumstances, a union of morphia with tartrate of antimony and potassa.

9. *Combination of Remedies.*—There are few acute surgical diseases or severe accidents in which a combination of several of the remedies now described may not be advantageously employed. In nearly every case of the kind the patient will be found to be oppressed with fever, thirst, pain, and restlessness; or, in other words, to labor under incited action of the heart and arteries, attended with diminished, if not suspended secretion, and all the evils consequent upon such a state of the system. To meet the indications of treatment, under such circumstances, there is no prescription which, according to my experience, is capable of conferring greater benefit than the saline and antimonial mixture, as it is termed, consisting of the following ingredients:—

℞. Antimonii et potassæ tart. gr. iij.
Magnesiæ sulph. ℥ij.
Morphiæ sulph. gr. j⅓.
Aquæ destil. ℥x.
Syr. zingiber. vel simplicis ℥ij.
Acid. sulph. aromat. ʒss.
Tinct. veratr. virid. ʒiss.
M.

Of this combination the proper average dose is half an ounce, repeated every two, three, four, or six hours, according to the exigencies of the case. Should it produce emesis, or distressing nausea, the dose must be diminished.

Properly administered, it rarely fails rapidly to subdue vascular excitement, to cause copious perspiration, to allay pain, thirst, and restlessness, to maintain the bowels in a soluble condition, and to induce sleep and general tranquillity. Instead of the veratrum aconite may be used; but in general I give the former the preference. Colchicum may be added when there is a rheumatic or gouty state of the system, and quinine when there is a tendency to periodicity. The quantity of morphia may be increased when there is much pain.

10. *Antiphlogistic Regimen.*—Under this head are comprised the patient's diet, and the care which he may require during his confinement. The subject is one which rarely receives the attention its importance demands.

Few persons, fortunately, have any appetite during the height of an inflammatory attack, and hence the surgeon seldom experiences any difficulty in regard to the regulation of the diet. The stomach being oppressed with nausea, or a sense of uneasiness, either loathes food, or rejects it almost the moment it is swallowed. It is well it should be so; for any ingesta, however mild, taken at this period, would only become a source of further trouble, by increasing the morbid action, perhaps already progressing at a furious rate. When the appetite remains, it must be repressed, steadily and courageously, until all danger from over-excitement from its indulgence has been safely passed. The mildest and least nutritious articles only are admissible in the earlier stages of the disease; such as panado, gruel, arrowroot, sago, and tapioca. Not even the lightest animal broth is permissible, unless there is decided tendency to prostration, or an irritable state of the system, clearly dependent upon the want of proper nourishment, as occasionally happens in persons of a nervous, irritable temperament, or who are habitually huge feeders. The drinks should be cooling, consisting of iced water, gum-water, linseed tea, or barley-water, either simple, or slightly acidulated with lemon-juice, tamarind, or any of the subacid fruits; care being taken that, while they are used freely, they are not employed in such quantity as to produce gastric and intestinal oppression.

The promptings of nature should not be disregarded during the progress of recovery; for their tendencies are generally wholesome, and should therefore be gratified to at least a reasonable extent, unless there are well-marked contra-indications. Acid drinks and food are particularly apt to be craved, and a moderate use of them is often eminently beneficial, not only in whetting the appetite, but in promoting the digestion, by supplying the exhausted stomach with substances calculated to atone for the want of a due amount of gastric juice, so essential to healthy chymification. Improper indulgence should, of course, be avoided, and care must also be taken that the articles are of such a character as to prevent acidity and flatulence.

Rest of mind and body must be carefully observed. The importance of this is so self-evident that it would be folly to attempt to enforce it by any labored argument. Whatever has a tendency to excite the heart's action must necessarily increase the momentum of the circulation, and, through it, the inflammation. In all severe attacks the patient must keep his bed, from which he must not rise even to answer nature's calls; light and noise are carefully excluded from his apartment, especially if he is suffering from inflammation of the eye, brain, or ear; and no persons should be permitted to be about him, except such as are absolutely necessary to nurse him. Many a patient is killed by the kindness of his friends and relatives.

Attention must be paid to the temperature of the patient's room, this being regulated, not by his feelings, which are often deceptive, but by the thermometer. On an average, it should not exceed 65°, but in some cases it may range as high as 70°, and in others as low as 60°. The apartment should be frequently ventilated. When it is recollected how soon the air becomes vitiated during sickness, and how important a due supply of oxygen is to the proper maintenance of the health, the importance of attention to this subject will not be doubted. Cleanliness of the body, and of the bed-clothes, is another subject of vital importance in the treatment of inflammation, and one to which, I am sure, few practitioners pay sufficient attention. To medicate the inside of a patient while we neglect the outside is one of those singular inconsistencies of which we see daily proofs in the sick chamber. I would not insist upon too frequent ablutions and changes of the body and bedclothes, but they should certainly, in ordinary cases, be effected at least once in the twenty-four hours; care being taken to avoid unnecessary exposure and fatigue during their performance. Even the arrangement of the furniture should be attended to, on the principle that an agreeable impression, of whatever kind, is more conducive to comfort and recovery than one of an opposite character.

II. Local Treatment.—The local remedies of inflammation consist of rest and elevation of the affected part, the abstraction of blood, cold and warm applications, compression, destructives, and counter-irritation.

1. *Rest and Position.*—Without rest, steady and persistent, of the affected part, little progress can be made toward the cure of inflammation. The practitioner who neglects attention to this important circumstance, performs only half his duty. The patient, ignorant of its advantages, often continues to exercise the affected organ long after it has become unfitted for the discharge of its functions, much to his present discomfort and ultimate detriment. A simple conjunctivitis, that might be cured in a few hours, is often urged, for the want of a little rest of the eye, into a violent and protracted ophthalmia, perhaps, at length, eventuating in total loss of vision. An inflamed joint is frequently, for the same reason, rendered permanently stiff and useless. Hence, rest is universally considered as one of the most essential elements of the local treatment of inflammation. In general, it is easily procured, simply by the patient's own efforts; but where this is not the case, it must be insured by appropriate splints, and other means, applied so as not to interfere with the other treatment. In inflammation of some of the internal organs, as the heart, stomach, peritoneum, bowels, and urinary bladder, the object is sought to be obtained by the liberal use of anodynes, which, by temporarily paralyzing the muscular fibres of the affected structures, effectually prevent peristaltic motion, and thus place them in a better condition for speedy recovery.

But there is a period when rest must not be enforced too rigidly, for when it is continued too long, it may be productive of much harm. Its great utility is in the earlier stages of inflammation, when morbid action is gravescent, and for some time after it has reached its culminating point. As soon as recedence has fairly begun, motion, gently and cautiously conducted, is often of great utility.

Not only should the part be kept at rest, but it should also be maintained in an elevated position, the success of the treatment being thereby greatly enhanced. The importance of attention to this point is well exemplified in many familiar diseases. The patient himself is often conscious of it, and, therefore, resorts to it, as it were, instinctively. Who that has ever had an attack of whitlow, does not remember the great relief which he experienced from carrying his hand in an elevated position? The effect of position is nowhere more strikingly evinced than in odontalgia. During the day, the patient, while attending to business, is, perhaps, hardly sensible of suffering, but, at night, no sooner does his head touch the pillow than the tooth begins to ache and throb, compelling him to get up and pace his room. In orchitis, the beneficial effects of our remedies are always greatly aided by elevation conjoined with rest of the affected organ. It is quite easy to understand why this should be so. In inflammation, the vessels carry an extraordinary quantity of blood, which is still further increased when the suffering structures are placed in a dependent position, because the flow, not being opposed by gravity, has then free scope, thus crowding the already distended capillaries to the very utmost, and proportionably aggravating the morbid action.

Finally, the inflamed part should also be maintained in as easy a position as possible, mere rest and elevation not sufficing to insure comfort. All restraint must be taken off; all muscular contraction counteracted. Thus, in inflammation of the knee-joint, the limb should recline upon its outer surface, a pillow being placed in the ham, this being the best position for preventing tension. In synovitis of the elbow-joint, the forearm is bent at a right angle with the arm; and in hip-joint disease, the thigh is slightly flexed upon the pelvis, and turned towards the sound one.

2. *Local Bleeding.*—Blood may be abstracted locally by scarification, puncture, leeching, and cupping, each being more or less serviceable, in its own way, in particular cases and under particular circumstances.

The manner in which topical bleeding affords relief is sufficiently evident in some of these forms of depletion, but not very apparent in others. Thus, in scarifying and puncturing a part, the blood is taken directly from the engorged vessels, which are thus drained of their altered and vitiated contents. If the operation be carried to any considerable extent, as it often may be, especially in the former of these procedures, we may, at the same time, make a powerful impression upon the general system, nearly as rapidly and quite as effectually as when blood is drawn from a vein at the bend of the arm, although, in general, such an effect is neither aimed at nor desired. A similar influence is exerted by leeching and cupping, provided the operation is performed upon the inflamed surface, or in its immediate vicinity. Frequently, however, it is performed at a remote point, and then its mode of action is rendered more difficult of comprehension. Thus, in inflammation of the brain, it is difficult to determine how leeches and cups, applied to the nape of the neck, the temples, or back of the ear, afford relief to the affected organ. It is certainly not possible, in such a case, to make any direct impression upon the seat of the disease; whatever influence is exerted, must be exerted through the general system. This is a self-evident proposition. The vessels of the neck and scalp have no direct communication with the vessels of the brain; and hence, in leeching and cupping these parts, we can no more drain the cerebral capillaries than we can drain those of the hand, chest, or any other distant part. We may assume, then, that, when topical bleeding is practised by either of the latter methods, its beneficial effects are due not to any direct drainage of the suffering structures, but indirectly to the depressing influence which it exerts upon the heart and nervous system, and, through them, upon the morbid action, diminishing the momentum of the circulation, and, consequently, the flow of blood in the capillaries at the seat of the inflammation.

But whatever may be its mode of action; whether it affords relief in the manner in which we have attempted to explain, or by some revulsive agency so much insisted upon by some of the older practitioners, and which it is so difficult to comprehend, topical bleeding, to be efficient, should always, if possible, be preceded by general depletion. When the force of the morbid action has thus been broken, the rest of the malady is often well dealt with by local abstraction of blood. It is only when the disease is very mild, or when there is no marked constitutional disorder, that this rule should be disregarded. Under such circumstances, the treatment may occasionally be very properly commenced with the application of leeches, cups, or scarification, followed or not, as the exigencies of the particular case may seem to require, by other measures. The manner of taking blood topically will be pointed out in the chapter on Minor Surgery.

3. *Cold and Warm Applications.*—These remedies, which are more particularly adapted to external inflammations, comprise a great number of articles, in the form of water dressings and cataplasms, with the character of which every practitioner should be perfectly familiar. Both classes of remedies may be simple or medicated, according to the tolerance of the part and system, and the nature of the morbid action.

(1.) *Cold water* has been employed in the treatment of inflammation almost from time immemorial; but its beneficial effects were almost forgotten, until attention was recalled to it by some of the military surgeons of Europe, early in the present century. In this country, the subject has hardly yet received the consideration it deserves, the use of the article having hitherto been confined chiefly to hospital practice. From its value, however, as a topical application, it must soon find its way to general favor, and take its place among the great remedies for the cure of inflammation, especially as it occurs in the external parts of the body.

It is not difficult to conceive how cold operates in subduing morbid action. Its chief effect is evidently that of a sedative, lowering the temperature of the part, and causing contraction of the vessels, thereby relieving pain, swelling, and tension. It is particularly applicable to inflammation in its incipient and gravescent stages, while there is, as yet, little effusion, and no serious structural lesion. When the action has reached its acme, threatening suppuration, or, what is worse, tending to gangrene, it is usually hurtful both to part and system, and must be promptly discontinued. Besides, it should not be forgotten that cold, when intense, or protracted, may of itself cause gangrene. Young and robust persons usually tolerate such applications much better than the aged and feeble; they are also better borne in summer than in winter. As it is impossible always to determine beforehand, in any given case, what their effects will be, their action should be carefully watched, in order that, if they should become a source of annoyance, they may either be entirely dispensed with, or employed in a modified form.

The water may be rendered anodyne, astringent, or antiseptic, according to circumstances, by the addition of opium, acetate of lead, or some of the chlorides. The best way to use it is to cover the affected part with a piece of old porous linen, and to direct upon it a constant flow of water from a basin with a stop-cock, slung to the top of the bedstead, the limb lying on an oil-cloth trough, from which the fluid is conducted into another vessel standing near the bed. Or the part may be covered with a wide, thin piece of sponge, spongio-piline, or common linen, over which is placed a bladder partially filled with pounded ice. Or the water may be conveyed from a basin by means of a candle wick to a layer of lint upon the inflamed surface, the wick acting on the principle of a syphon. Finally, when ice cannot be obtained, the water may be rendered cold by means of alcohol, in the proportion of one part to six of the fluid; by pyroligneous acid and alcohol; or by the admixture of a strong solution of hydrochlorate of ammonia and nitrate of potassa. In whatever manner the fluid is employed, the part to which it is applied should be constantly exposed to the air, to favor evaporation.

(2.) The use of *warm water* is also of great antiquity, having been employed by Hippocrates and other practitioners in gangrene and various cutaneous affections. It has, however, only been within the last fifteen years that it has assumed anything like the rank to which its importance as an antiphlogistic remedy entitles it. In my own practice, I generally give a decided preference to warm water over cold, the impression made by it upon the part and system being usually more agreeable and soothing, while there is much less danger of metastasis, or of a sudden transfer of disease from the external to the internal parts of the body. It is particularly adapted to nervous, irritable individuals, who are easily chilled by cold applications, and to cases in which the inflammation has already made considerable progress, where there is much tension and swelling, or where suppuration is impending, or has already taken place. A good rule, both in regard to warm and cold applications, is to consult the feelings of the patient, using one or the other according to the tolerance of the part and system, or simply so long as they seem to be beneficial. When a change becomes requisite, care must be taken that it is not too sudden, lest it produce harm. Thus, hot applications should be succeeded first by warm, then by tepid, afterwards by cool, and finally, if necessary, by cold, the transition being gradual and wary, not great and sudden, so as to shock the part and system, and thus cause undue reaction.

Warm water may generally be advantageously combined with opium, or with opium and acetate of lead, or with opium and hydrochlorate of ammonia. The latter is the preparation which I generally prefer, the opium and ammonia being dissolved in hot water, in the proportion of about two drachms of the former and an ounce and a half of the latter to the gallon of fluid. A piece of old flannel of suitable size, and arranged in several thicknesses, is then wrung out of the solution, and laid upon the inflamed surface, a covering of oiled skin being spread over the cloth, to confine the heat and moisture. As the cloth becomes dry, it is wet, from time to time, not by re-immersion, but simply by pressing the solution upon it from a sponge; dressing by substitution being necessary only in the event of the flannel becoming soiled and offensive by the discharges. The only objection to the hydrochlorate of ammonia is its liability to cause slight pustulation, especially in persons of a delicate skin; when this happens, its use must be suspended. In the employment of cold water, the part is exposed; in the use of warm, it is covered. The former does good by constringing the inflamed tissues, and opposing effusion; the latter by relaxing them, and favoring effusion.

(3.) *Fomentations*, which may be considered as a species of local bathing, are often beneficially employed in inflammation of the joints and of some of the internal viscera, being particularly calculated to relieve pain, tension, and spasm. In cystitis, gastritis, enteritis, and peritonitis, as well as in wounds and other injuries of the pelvic and abdominal organs, their employment can rarely be dispensed with in any case. The most simple fomentation consists of a large, thick flannel cloth, wrung out of hot water, or water near the boiling point, by means of two sticks turned in opposite directions, and applied lightly to the part as hot as it can be borne. If a soothing narcotic, or sedative influence is required, chamomile flowers, poppies, hops, or what is much better, laudanum, or laudanum and brandy, will be found to form valuable additions. In whatever manner they are used, they should be frequently renewed, care also being taken that there are two cloths, so that, while one is taken off, the other may be immediately applied, all danger of shock and reaction from exposure to the air being thus avoided.

(4.) *Stuping* is a variety of fomentation serviceable in many cases, but particularly in affections of the eye, nose, ear, mouth, and throat. It is conducted with a piece of flannel, rolled into a kind of ball, which the patient holds in a small pitcher, at such a distance from the affected surface that the vapor may ascend to it, care being taken to wet the cloth as often as it becomes cool. The remedy may be medicated, if desired, with laudanum, camphor, belladonna, hemlock, or any other article, anodyne, astringent, or sorbefacient.

When it is desirable to apply steam more directly, a funnel may be inverted over the hot fluid, and the tube held towards the affected surface at a suitable distance. Steam may be conveyed to any part of the patient's body, under the bedclothes, by means of a large gutta-percha tube, attached to a small tin boiler, placed upon a table, and heated by a spirit lamp.

(5.) *Poultices*, technically called cataplasms, are an important class of remedies, intended for external application in inflammation, wounds, ulcers, abscesses, and other affections. They are modifications of fomentations, and are made of various substances, either simple or medicated, according to the object they are intended to fulfil. They should be of such consistence as to accommodate themselves accurately to the surface to which they are applied, without being so tenacious as to adhere firmly to the skin, or so thin as to spread over the neighboring parts. They should never be heavy nor bulky, and they should be renewed as often as they become dry and cold; otherwise they lose their good effects and are converted into irritants. In general, it is sufficient to change them thrice a day; but in warm weather, or when there is much discharge, it may be necessary to reapply them every four, five, or six hours. Their temperature should be about the same as that of the body, that is, from 85 to 92 degrees of Fahrenheit, and they should be placed directly upon the affected surface in a uniform layer of from three to four lines in thickness, a piece of bobbinet, gauze, or thin netting being interposed to prevent sticking and facilitate removal.

The action of a poultice is usually limited to the skin, or, at all events, to the parts to which it is immediately applied; it is only when it is composed of very strong materials that its influence is more deeply felt. In using medicated cataplasms, it is necessary, especially when there is ulceration or abrasion of the skin, to be aware that the active ingredient may be absorbed, and thus produce the same effects as when introduced directly into the stomach. Poultices differ very much in their mode of action; thus, some are altogether emollient, that is, they soften and relax the parts to which they are applied, at the same time that they promote exhalation and absorption; some are anodyne; some astringent; some antiseptic.

The following list comprises nearly all that are now in use, with brief directions for their preparation:—

a. The *bread* poultice is made by pouring boiling water upon the crumbs of stale wheat bread and stirring the mixture in a basin with the back of a spoon until it is of a thick, mushy consistence. It is then spread upon a piece of folded cloth large enough to cover not only the affected surface, but to extend a short distance beyond it. Milk may be used as a substitute for the water, but when thus prepared the poultice requires to be more frequently changed, as it soon becomes sour and offensive.

b. The *arrowroot* poultice is prepared in the same manner as when that article is used for food, only that it is rendered more consistent; it is mixed at first with cold water, and then with a sufficient quantity of boiling water to convert it into a thick, gelatinous paste. This poultice is admirably adapted for irritable sores, and deserves to be more frequently employed than it is.

c. The *slippery-elm* poultice is prepared from the powdered bark of the slippery-elm, moistened with hot water. It is very light and demulcent, and, therefore, well adapted for burns, excoriations, and irritable sores.

d. The *linseed* poultice, perhaps the best and most convenient of all, from its emollient properties, is made of ground linseed mixed with boiling water, and stirred until it is converted into a thick, cohesive mass. This poultice is always very easily prepared, retains its heat for a long time, and has a sufficiency of oil to keep it soft and prevent it from adhering.

Excellent emollient poultices may be prepared from apples, carrots, turnips, or any of the more tender culinary roots, by boiling them, after having removed the skin, and mashing them into a soft pulp. They possess, however, no peculiar virtues, and are therefore seldom used.

A poultice may be variously medicated. Thus it may be rendered astringent by the admixture of acetate of lead, Goulard's extract, alum, or a decoction of oak bark; anodyne, by laudanum, opium, morphia, poppy-heads, or hemlock; stimulating, by chloride of sodium, vinegar, or port wine; absorbent, by iodine and other articles.

The *fermenting* poultice, used in foul, fetid, and painful ulcers, in hospital gangrene, and in mortification, is prepared by incorporating a pound of wheat flour with half that quantity of yeast, the mixture being afterwards exposed to a gentle heat until it swells. The port-wine poultice, which belongs to the same class as the fermenting, is made in a similar manner, except that it is not boiled.

The charcoal poultice, also a good antiseptic application, though now rarely used, is prepared from recently burned charcoal, reduced to a very fine powder,'and mixed with bread, oatmeal, or ground flaxseed. The objection to this poultice is its liability to discolor the affected parts, so as to prevent us from observing their real condition. This, may, however, be obviated, in great measure, by the interposition of a thin linen cloth.

A poultice may be rendered refrigerant by means of a freezing mixture, or a bladder partially filled with pounded ice and spread over its surface. Such an application, however, for reasons already stated, requires great care.

4. *Nitrate of Silver.*—There is no article which enjoys a higher reputation, as a local antiphlogistic agent, than nitrate of silver; certainly none that is more frequently employed. Without understanding its precise mode of action, experience has taught us its great value in the treatment of a large number of inflammatory affections, some of which it would be exceedingly difficult to cure without it, while nearly all are more or less benefited by it. Ever since its introduction into practice by Mr. Higginbottom, of England, as a topical antiphlogistic, it has been employed in almost every form of external inflammation, both in a solid and a fluid state. Indeed, very recently it has been employed, in the latter form, in cases of laryngitis, and one gentleman, Dr. Horace Green, of New York, has gone so far as to assert that he has even mopped the trachea and bronchial tubes with it. Its beneficial effects in diseases of the eye, throat, and genito-urinary organs have long been acknowledged by practitioners. In cutaneous affections, too, it enjoys a high and well-deserved reputation. In erysipelas it is perhaps more frequently used than any other single remedy, iodine alone excepted. Its value in the treatment of this disease, so common in this and other countries, is fully established, both in a curative and prophylactic point of view. In inflammation of the tonsils and fauces, whether the result of ordinary causes, of a strumous diathesis, or a syphilitic state of the system, no article is so generally employed, or enjoys so great a reputation, as the nitrate of silver. In gonorrhœa and gleet, in strictures and morbid sensibility of the urethra, in spermatorrhœa, in vaginitis, and metritis, nitrate of silver has become an indispensable means of cure. Indeed, it would be difficult to find an accessible disease, attended with preternatural vascularity and disordered structure, in which its application would not be productive of benefit.

Nitrate of silver may be used as a vesicant, as when it is applied to the skin, or simply as an alterant, or modifier of diseased action; for, as already stated, nothing definite is known of its mode of operation. When employed for blistering purposes, the solid form is usually preferred, the stick being passed lightly but efficiently over the surface, previously a little moistened with soft water, until there is evidence of slight coagulation of the albuminoid matter of the epidermis. A cloth, pressed out of warm water, is then applied, when vesication will soon follow. The same result may easily be produced by a saturated solution of nitrate of silver; but, as the remedy is less manageable, it is not often employed with that view. Unless applied in a very concentrated form, and for an unusual length of time, nitrate of silver never acts as an escharotic, or as a destroyer of the tissues.

The solid nitrate of silver is often used with great advantage in ulceration of the mouth and throat, the cornea, the skin, vagina, and uterus, the application being usually made very lightly, and repeated not oftener than once every third, fifth, or eighth day. Employed too frequently or too abundantly, it often does immense harm, not only occasioning severe pain, but sometimes seriously aggravating the morbid action. These effects may be produced equally by a strong solution as by the solid stick. A strong collyrium of nitrate of silver has destroyed many an eye, or urged on an inflammation, perhaps on the very verge of resolution, to a most distressing extent. Urethritis is often aggravated, and greatly protracted, by a strong injection of this description. Much judgment, then, it will be perceived, is requisite in the local use of this remedy, not only as it respects its strength, but also the mode and time of its application. Carefully adapted to the exigencies of each particular case, it exerts a powerful impression upon the diseased structures, diminishing vascular action, relieving pain, and destroying morbid sensibility, often so conspicuous in inflammation of the eye and throat, and which nothing else can so well control.

5. *Iodine.*—Hardly less valuable than nitrate of silver, as a topical remedy in inflammation, is iodine, first introduced to the notice of the profession, in this relation, by Mr. Davis, an English surgeon. It is generally used in the form of the officinal tincture, either pure or diluted with alcohol. Its great value seems to consist in its alterant and sorbefacient properties, changing the action of the capillary vessels, and promoting the removal of effused fluids. That this is the case is sufficiently apparent from what takes place in erysipelas of the skin, where the effects of the remedy may always be easily watched. Within a few hours after the application has been made the swelling is usually observed to be so much diminished as to cause a marked corrugation of the surface, attended with a diminution of pain and hardness; circumstances plainly denotive of lessened vascular activity, and progressive absorption. Similar effects are witnessed when the application is made to an œdematous uvula, scrotum, or eyelid, there being not only no further effusion afterwards, but a removal of what was previously deposited. From these facts, it may be inferred that iodine, locally applied, is not merely, as has sometimes been asserted, a sorbefacient, but also an alterant, or modifier of secernent action.

Although exceedingly valuable as an antiphlogistic, it is questionable whether iodine has received the attention it really deserves, or whether we are sufficiently acquainted with the class of cases to which it is more particularly applicable. Its reputation in erysipelas seems to be fully established, and I have certainly myself found no article at all comparable to it in that affection as an endermic remedy. It is also of great service in boils, carbuncle, whitlow, corns, bunions, and inflamed, irritable ulcers of the extremities. Its beneficial effects are hardly less conspicuous in active œdema of the uvula and tonsils, the legs, scrotum, prepuce, and pudendum, a single application often sufficing to produce the most marked change in the condition of the part. As a collyrium and an injection, the value of iodine has not been sufficiently tested to enable us to form any definite opinion, but the trials that have been made with it, in this respect, are encouraging, and deserving of repetition.

For external use, I generally employ the tincture of iodine with an equal amount of alcohol, applying the mixture by means of a camel-hair pencil until the skin becomes of a deep yellowish color. The application may be repeated once every eight, twelve, or twenty-four hours, according to the exigencies of each particular case. If the remedy be used stronger than this it will be very apt to produce severe pain and to excite capillary action; two circumstances concerning which it is impossible to exercise too much caution. When intended for the tonsils, uvula, and other delicate parts, the dilution should, for the reason just mentioned, be still greater.

6. *Compression.*—Compression, as an antiphlogistic agent, has been too much neglected, nor has it always been judiciously used when resorted to. That it is capable of doing an immense deal of good, when employed with proper care, and under suitable circumstances, my experience fully justifies me in asserting. Why it is so rarely used, it is difficult to determine, unless it is that practitioners do not possess the requisite skill in its application and mode of management. Very little, certainly, is said about it in surgical treatises; and, as to our teachers, few seem to be aware that there is such an agent. My space will not permit me to enter as fully into the subject as I would desire; a mere outline of a few of the more important facts connected with it must, therefore, suffice.

Compression, although more particularly applicable to the latter stages of inflammation, is yet not without its value in the incipient and gravescent periods of the disease. Affording support to the affected structures, it is well calculated, when early employed, to give tone to the distended capillaries, enabling them to urge on their sluggish contents, and, consequently, to prevent their effusion into the surrounding cellular tissue. Immense good is often done in this way, as every one knows who has ever treated erysipelas, wounds, fractures, and dislocations, by compression. If two cases of any one of these affections, of precisely the same character, could be treated, one with the bandage, and the other without the bandage, simply by the ordinary topical remedies, the difference would be most striking. The compressed limb would be comparatively free both from pain and swelling, whereas the other would be highly sensitive and greatly enlarged, from inflammatory deposits. We see, in such circumstances, how, in the one limb, action is controlled, and how, in the other, it pursues its wayward course. But this is not the only benefit which systematic compression is capable of affording. When judiciously employed, it controls muscular contraction, and thus prevents spasm, both of which are frequently so annoying in fractures, dislocations, amputations, and various affections of the joints. Another effect, and that by no means the least striking and important, is the sorbefacient influence which it exerts, rousing the absorbent vessels, and compelling them to remove the fluids that were deposited prior to the employment of the remedy. It is for this reason that compression may be so advantageously used in the latter stages of most of the external inflammations, attended with effusions of serum and fibrin, there being no means known to the surgeon so well calculated to effect this important object, and to assist in restoring the functions of the suffering parts. The treatment of orchitis by compression affords a beautiful and satisfactory illustration of the mode of action of the remedy under such circumstances. When this disease has been shorn of its violence by depletion, the swelling and induration, consequent upon the morbid action, often promptly disappear under the influence of systematic compression; generally, indeed, in one-fifth of the time in which they disappear under the use of mercury and ordinary sorbefacients. The absorption is frequently so rapid as to render it necessary to change the dressings twice in the twenty-four hours. Similar effects are sometimes observed in inflamed and enlarged joints.

been practised, by which the inflammation has been robbed of its violence, their effect being always more prompt and decisive under these circumstances. The new disease is generally established close to the original one, but occasionally at some distance from it. Thus, in inflammation of the hip-joint, the counter-irritant is usually applied as near as possible over the acetabulum and head of the thigh-bone, the immediate seat of the morbid action, and so with the other articulations. In disease of the neck of the bladder and prostate gland, it is applied to the perineum; of the pleura and lungs, over the nearest point of the chest. In inflammation of the eye, on the contrary, the irritation is established on the nape of the neck, behind the ear, or on the arm, and not in the immediate vicinity of the suffering organ. Great judgment is often required to determine the precise point where, as well as the precise time when, the new action ought to be instituted. If it be too near the original affection, it may run, as it were, into it, and thus cause an aggravation, instead of a mitigation of the mischief; if, on the other hand, it be too remote, it may entirely fail of the object for which it was employed. Counter-irritation, as already stated, is never resorted to until the system has been relieved of plethora, and the morbid action weakened by other remedies. Used in the height of the morbid action, it can scarcely fail to be productive of local and constitutional disturbance, calculated to exercise a prejudicial influence upon the progress and termination of the case.

Although the class of counter-irritants comprises a large number of articles of a very diversified character, they may with great propriety be arranged under two heads, according to their mode of action, as vesicants, and suppurants.

(1.) *Vesicants* are remedies which, when applied to the skin, elevate the epidermis in the form of blisters filled with serum. They are of great value in the treatment of inflammation, both acute and chronic, and are applicable to a great variety of circumstances, with which the practitioner should be fully acquainted. The articles commonly used for this purpose are cantharides, either in powder or in the form of collodion-liquid, ammonia, and hot fluids. In acute disease these means, especially the first, are always preceded by active depletory measures, it being well known that, if they are employed before there has been a proper reduction of the system, they are liable to do mischief by increasing the local and general excitement. In chronic inflammation, however, they may often be advantageously used at the very commencement of the treatment. The vesicating agent is generally placed as near the affected part as possible; sometimes, indeed, directly over it.

Blisters, properly so called, are prepared with the common fly ointment of the shops, and vary in shape and size according to the object they are intended to fulfil, or the region to which they are applied. The part, if covered with hair, is previously shaved, and the plaster is confined with a compress and roller, or, what is better, with a few adhesive strips. To prevent strangury, an object of great importance in all cases, but particularly in persons of a nervous temperament and in young children, the surface of the blister should always be sprinkled with a few grains of morphia and camphor. The same end may be obtained, though less certainly, by the interposition of a piece of tissue paper, steeped in spirits of camphor. In addition to these precautions, the patient should be requested to make free use of some mucilaginous drink, as flaxseed tea, or gum Arabic water, either alone or combined with a little spirit of nitric ether. If strangury should occur, prompt relief may usually be afforded by a laudanum enema, and hot fomentations to the genitals and hypogastric region, aided, if necessary, by a dose of morphia by the mouth.

A blister should, on an average, remain upon the part from six to eight hours, unless the skin is very delicate and sensitive, when a shorter period class comprises permanent blisters, setons, and issues, which will receive particular attention in the chapter on Minor Surgery.

SECT. III.—CHRONIC INFLAMMATION.

Chronic inflammation is distinguished from acute by a variety of circumstances, which it is of the greatest importance to be able thoroughly to appreciate and understand. Its study, in fact, is of paramount consequence, and I am sure it is not placing too high an estimate upon its value when it is asserted that there is much greater merit in being able to diagnosticate a chronic disease, than to determine the nature and seat of an acute one. When a lesion declares itself, openly and boldly, by a well-marked train of symptoms, the practitioner must indeed be ignorant, if not positively stupid, if he cannot discriminate with tolerable accuracy between it and other affections which may simulate it, or bear some resemblance to it; but it is very different when the malady is of an obscure, chronic character, lurking in the system, no one, perhaps, knowing where, even after the closest and most patient scrutiny. It is under such circumstances that the intelligent pathologist and observant practitioner often appears to the greatest advantage, by turning his knowledge to the best account for his patient.

It does not comport with the design or scope of this work to enter into any of the more minute details of this subject; a large volume might be written upon it, and even then it would not be exhausted. A mere sketch of its more prominent features is all that I shall attempt.

Chronic inflammation is of great frequency, and is liable to appear in all organs and tissues of the body; it is generally a consequence or sequela of the acute form, but cases occasionally arise in which it would seem to be a primary affection. Strictly speaking, such an occurrence is of course impossible; all that we mean, when we use the word in this sense, is that the disease which it serves to designate is of so stealthy and insidious a character as to escape, for a considerable time, the attention both of the patient and his physician; the person is unwell, perhaps occasionally a little feverish, or the subject of headache, want of appetite, or a sallow complexion and constipated bowels; or, it may be, he has a cough, and a pain in his side; or a joint becomes sore and stiff; and still he is able to go about, and attend to business, although he is soon fatigued, and rendered uncomfortable by it. Thus a week, a fortnight, or a month may be passed, when, a careful examination being instituted, the discovery is made that there is grave disease in some important organ, and that it has perhaps already gone so far as to render recovery absolutely impossible, however skilfully the case may now be treated. The disease has been latent, or nearly so; it has failed to make itself known by any distinctive train of phenomena, and the result has been that both patient and practitioner have been lulled into fatal security. The morbid action has been lying all this time in ambush, and is now, in the true sense of the term, chronic. Such cases are by no means unfrequent, and they should serve to admonish us never to neglect any symptoms, however trivial, in our clinical investigations. A pain, a soreness, a cough, a halt in the gait, may, if properly interpreted, afford useful information in regard to the diagnosis of chronic disease, and should teach us the value and importance of patience and caution in the examination of the sick. The slightest neglect may be fatal; a little spark may kindle a devouring flame.

Chronic inflammation, however provoked, is generally tardy and sluggish in its movements, creating little constitutional disturbance, but not, on this account, the less surely and effectually undermining the part and system. In the acute variety, the action is rapid, bold, daring; suffering is severe; and constitutional response loud and unmistakable. In chronic inflammation, on through them in a very tardy and sluggish manner, strikingly contrasting with the force and rapidity with which it is transmitted in the acute form of the disease, where all is power and activity, especially in its earlier stages. When the inflammation is very protracted, many of the smaller vessels have a varicose, tortuous appearance, and are so crippled as to be almost unable to send on their contents at all. Hence, congestion, often deep and extensive, is generally present, both at the focus of the morbid action and for a considerable distance around.

Treatment.—In the treatment of chronic inflammation, the indications are, first, to remove the exciting cause of the disease; secondly, to correct constitutional disorder; and lastly, to promote the absorption of effused fluids and restore the tone of the crippled and dilated vessels.

The removal of the exciting cause of the disease obviously demands the same attention here as in the acute variety of inflammation; whenever it is accessible it should be promptly disposed of. All officious interference must of course be avoided.

Restoration of the secretions constitutes a most important indication, as it is upon their derangement or suppression that the morbid action in chronic inflammation so often depends. The remedies that are chiefly to be relied upon, for this purpose, are mercury, tartrate of antimony and potassa, iodine, bromine, nitro-muriatic acid, purgatives, and a judiciously regulated diet.

In placing mercury at the head of this list of remedial agents, I am only endeavoring to show the high estimate that is so justly attached to it in the treatment of chronic inflammation. If its administration is of doubtful propriety in many cases in the acute variety of the disease, there are few instances of the chronic in which it may not be beneficially exhibited, and yet, in making this remark, it must not be understood that I would give mercury indiscriminately or sakelessly. Its value is unquestionable, but, still, there are cases and circumstances in which it is utterly inadmissible; this is especially true of those cases of chronic inflammation which are so often met with in scrofulous children, and in persons of enfeebled and broken-down constitution, where mercury, in almost any form, is generally most pernicious, the smallest quantity sometimes producing profuse ptyalism, or gangrene of the mouth.

In administering this remedy for the cure of chronic inflammation, the surgeon has it in his power to make choice of a much greater number and variety of articles than in acute inflammation, in which he is obliged to restrict himself chiefly to calomel and blue mass. In the chronic form of the disease, he has, in addition, the bichloride, the protoiodide, cyanuret, and phosphate, which exert a most salutary influence in changing the capillary action of the part, and promoting the removal of effused fluids. Whatever substance be selected, the dose should be very small, and not repeated oftener, on an average, than twice or thrice in the twenty-four hours. The object is to produce a slow and gradual effect, and for this purpose it will generally be necessary to continue the remedy for several successive weeks. Active ptyalism is carefully avoided; it will be quite sufficient if we succeed in obtaining slight soreness of the gums. If calomel be used, a good average dose will be from one-sixth to one-half of a grain.

In children, the most suitable mercurials are blue mass, corrosive sublimate, and the hydrargyrum cum cretâ, or gray powder, given either alone or in union with soda, soda and columba, quinine, or Huxham's tincture of bark.

Iodine and its various preparations, as iodide of potassium, iodide of iron, iodide of cadmium, and Lugol's solution; bromide of potassium; barium; and tartar emetic; often exert a most salutary influence over chronic inflammation, and are particularly indicated where a slow, alterant effect is required. With plaints which owe their origin, either directly or indirectly, to disorder of the uterine functions.

The local treatment of chronic inflammation is often a matter of paramount importance. It comprises, first, rest and elevation of the parts, the same as in acute disease; secondly, leeching, scarification, blistering, iodine, and nitrate of silver, especially in the earlier stages; thirdly, counter-irritation by croton oil, tartar emetic, issues, setons, and the actual cautery; and, lastly, sorbefacients, such as stimulating liniments, embrocations, and unguents, the cold douche, compression with the bandage, or adhesive strips, electricity, and dry friction.

CHAPTER IV.

TERMINATIONS AND RESULTS OF INFLAMMATION.

SECT. I.—DELITESCENCE AND RESOLUTION.

THESE terms are used to denote the restoration of the inflamed structures to their normal condition. The word delitescence is of Latin derivation, and literally signifies to abscond; it was introduced into surgical nomenclature by the French writers, and is employed to designate the sudden disappearance of inflammation, before it has passed through its different stages, and, consequently, before it has occasioned any serious structural changes. It is unquestionably the most desirable mode of termination, and may occur either spontaneously, or from the slightest treatment. A catarrh, caused by exposure to cold, and perhaps threatening to be quite severe, often aborts during a profound sleep induced by a warm bed, or a hot foot-bath and a grain of opium. An inflammation of a lymphatic ganglion of the neck, coming on late in the evening, and attended with great tenderness on motion and pressure, together with considerable swelling, often rapidly disappears under similar measures. An incipient gonorrhœa frequently aborts under the use of a mild injection of nitrate of silver or acetate of lead; and who has not seen a bubo promptly vanish under steady, systematic compression, aided by the application of a solution of iodine? Inflammation produced by the presence of a foreign body generally rapidly disappears after the removal of the exciting cause of the morbid action.

The above facts, with many others that might be brought forward, if it were deemed necessary for my purpose, teach us two most important lessons: the first, is always to remove as early as possible the exciting cause of the inflammation; and the second, to enter upon the treatment of every case of the disease without the least delay. The object, invariably, should be to save structure, and the best way to do this is to make the disease abscond, or delitesce. Such an event, however, is only desirable when the inflammation can be dislodged more or less completely without the risk of throwing it upon some other and, perhaps, more important organ. Thus an attack of gout in the great toe would be a trifling affair in comparison with an attack of gout in the heart, brain, or stomach; and hence it would be far better, where there is danger of such a translation of irritation, to let the original disease pursue its course than to attempt to arrest it by means calculated to favor such a result. A severe injection may suddenly arrest an incipient gonorrhœa, but it may do infinite harm by the rapid induction of orchitis, which perhaps no treatment, however judiciously conducted, may be able to dispel completely under several weeks, if, indeed, under several months.

The sudden disappearance of inflammation from one structure, or set of structures, and its invasion of another, usually known by the term metastasis, suggests the importance of proper watchfulness on the part of the surgeon to prevent such an occurrence; or, if it have already taken place, to employ such means as shall be calculated to recall the morbid action as speedily and as effectually as possible to its original situation. For this purpose free use should be made of counter-irritation, in the form of stimulating embrocations, sinapisms, and blisters, aided, if the organ affected be one of great importance to life, by the abstraction of blood and full doses of opiates. If, in this way, the disease cannot be recalled, the treatment will go far to put a speedy stop to its violence and its tendency to extension.

The term resolution denotes the gradual dissipation of inflammation after the disease has made some progress and done some mischief, but before it has reached the suppurative crisis, or committed such ravages as to prevent the affected tissues from regaining their original properties. With such an issue effusion of serum and lymph is not at all incompatible, as these fluids may be entirely absorbed; a similar remark is applicable to pus, provided it exist in small quantity, and not in the form of an abscess, in which there is always more or less waste of tissue; and even to pure blood, which, if not too abundantly effused, or deprived of its vitality, is generally readily amenable to the action of the absorbents.

When resolution is about to occur there is a gradual and steady subsidence of the morbid action, as denoted by the changes in the local and constitutional symptoms. The discoloration, heat, pain, and swelling become less and less in consequence of the contraction of the vessels and the absorption of the effused fluids; the febrile disturbance goes off; and the part and system, no longer feeling the effects of the disease, at length regain their former condition. Often many weeks, and even several months, elapse before the restoration is finally completed. The absorbent vessels, kept in abeyance by the vascular action and the effused fluids, are slow to resume their functions; they act at first hesitatingly, as if afraid to enter upon their labor, but as the work progresses they acquire confidence, and, at length, setting about it in good earnest, they ere long finish their task, drinking in, as it were, all that their oppressors, the secernents, had previously poured out, and thus leaving the parts in a condition to regain their primitive characters. The bloodvessels usually remain dilated, feeble, and sluggish for some time after the complete subsidence of the disease, and there is also frequently more or less perversion of special sensation.

SECT. II.—DEPOSITION OF SERUM.

A deposition of serum, or of the watery elements of the blood, is a common attendant upon inflammation, and in some cases constitutes the principal, if not the only evidence of its presence. The structures which supply it in greatest abundance, when thus affected, are the cellular and serous, the secernent vessels of which are generally extremely active, even when the disease is comparatively mild. Large quantities of serum are also occasionally poured out by the mucous membrane of the alimentary canal, especially by that of the colon and rectum, as is observed in certain forms of diarrhœa and infantile cholera. Inflammation of the skin, unless produced by scalds, blisters, erysipelas, and the various bullar diseases, yields this fluid generally very sparingly. Very little is also effused in inflammation of the muscles and fibrous membranes, the nerves and vessels; while tendon, cartilage, and bone do not afford any, however severe the lesion. A similar remark is applicable to inflammation of the parenchymatous and glandular organs, as the lung and liver. In the cellular tissue serous accumulations are particularly liable to occur wherever this substance is most loose and abundant; hence they are very common in the eyelids, scrotum, prepuce, labia, nymphæ, legs, and feet, which are often enormously distended in consequence. Œdema of the glottis is an example of watery deposit in the submucous cellular substance of the edges of the windpipe. In the splanchnic cavities and the movable joints serum often collects in immense quantities; sometimes as an effect of acute, but more frequently as a result of chronic inflammation.

that, save the mechanical inconvenience which the fluid occasions, the patient is hardly conscious of any suffering whatever. Yet even in such cases it will generally be found, on dissection, that the serous membrane which furnished the water, exhibits sufficient indication of the lesion, as afforded by the opaque and thickened condition of its substance. It may be questioned whether mere congestion is capable of producing serous effusion. At first sight such an occurrence would seem to be quite probable; but a careful examination of the subject soon dispels the illusion. Permanent obstruction of the abdominal cava will cause ascites; not from congestion of the vessels of the peritoneum, but as a consequence of its inflammation, the result of the previous vascular engorgement. It is easy to see that vessels habitually distended must soon take on incited action, followed by abnormal deposits. A familiar illustration of this is afforded in the conjunctiva, where, if the vessels are at all engorged even for a short time, inflammation is sure to follow, unless the exciting cause of the determination be removed. If this mode of reasoning be correct, it follows that obstruction of the circulation, however induced, will, if permitted to continue, be soon succeeded by inflammation, of a grade and character sufficient to cause at least an effusion of serum, if not also of other fluids.

Of the nature of the morbid action, when serum is rapidly supplied, or when it is associated with other deposits, as lymph or pus, there can be no doubt; it is eminently inflammatory, and nothing else. The concomitant symptoms, and dissection after death, clearly establish the fact. The rapid and profuse serous exhalations which occur in acute pleurisy, peritonitis, and arachnitis admit of explanation in no other way; they are the appropriate products of these structures, and hence they are generally poured out quite early in the disease.

Effusion of serum is often associated with, if not remotely dependent upon, an impoverished and watery condition of the blood, accompanied by a marked decrease of fibrin and red particles. If, under such circumstances, inflammation be lighted up in almost any of the tissues, especially the cellular and serous, serum cannot fail to be supplied in large quantities, since, in consequence of the diminution of the plastic properties of the blood, there is nothing to restrain its exudation. Hence such action is very prone to be followed, externally, by anasarca, or œdema, and internally by dropsy.

The *symptoms* produced by this deposit are such, mainly, as are denotive of mechanical obstruction. In the eyelids, scrotum, prepuce, vulva, glottis, and legs, it is marked by a soft, inelastic swelling, which pits on pressure, and imparts a peculiar glossy appearance to the affected surface; attended, especially in the inferior extremities, with pain, heat, and more or less discoloration, usually of a pale dusky hue. A sense of distension is also commonly a prominent symptom. In œdema of the glottis there is serious impediment in the respiratory function, while in accumulations of water in the splanchnic cavities there must necessarily be more or less oppression, with displacement of the contained viscera. A large collection of water in the chest may not only cause collapse of the lung on one side, but greatly encroach upon the opposite one, and at the same time throw the heart completely out of its natural position, depress the diaphragm, and tilt up the intercostal spaces so as to give the thorax a vaulted configuration. In infiltration of the cellular tissue of the legs, feet, scrotum, and vulva, the fluid may, by its pressure upon the capillary vessels, cut off the supply of blood from the skin, and thus become a source of mortification, as we see exemplified in erysipelas and anasarca.

Treatment.—In the treatment of serous effusions, the main indication is to promote the absorption of the offending fluids by the use of hydragogue cathartics, diuretics, and mercurials; followed, when these means fail, by a puncture for their efficient evacuation. The most important cathartics, after thorough purgation, are jalap and bitartrate of potassa, citrate of magnesia, and elaterium, given in doses proportioned to the strength of the patient and the tolerance of the stomach and bowels. These remedies, as well as others of a kindred nature, produce their beneficial effects by establishing a drain upon the serous capillaries of the alimentary canal, which leads indirectly to the absorption of the serous accumulation. When mercurials are required, as they will be when there is obstruction of the portal circle, with deficiency of the biliary secretion, the most eligible articles will be calomel, blue mass, or corrosive sublimate, either alone or in union with elaterium, squills, digitalis, or antimony, according to the nature of the collateral disorder. Deficiency of the renal secretion must be met by suitable diuretics.

When the accumulation of serum is very great, as in cases of dropsy of the chest, abdomen, or pericardium, all internal treatment will be likely to prove abortive, from the fact that it is generally impossible, under such circumstances, to arouse the absorbents to a sense of their duty; the pressure of the fluid keeps them in a crippled and paralyzed condition, altogether incompatible with the healthy exercise of their functions. Hence, instead of wasting our time and the strength of our patient, as is unfortunately too often done in such cases, early recourse should be had to an operation with a view of affording vent to the pent-up matter. I am certain, from frequent observation, that serious and even fatal errors are constantly committed by practitioners from their indisposition to early interference with the trocar in these accumulations. They forget that their purgative, diuretic, and alterative remedies, if available at all, can prove beneficial only at the expense of much distress and exhaustion of the system, which too often leave the sufferer, in the event of his recovery from the disease, with shattered and broken health for years afterwards, if not during the remainder of his life. An operation, on the other hand, generally affords prompt and efficient relief to the urgent symptoms, and places the part in a condition to be influenced by sorbefacient measures.

Local remedies are available chiefly in serous effusions in the external parts of the body. In œdema of the extremities vast benefit is often derived from steady and persistent elevation, and regular, equable compression with the bandage, extending upwards from the distal portion of the limb. In this way support is given to the capillaries, while a salutary stimulus is imparted to the absorbents, well adapted to rouse them into action. This treatment often derives important aid from frictions with sorbefacient unguents, liniments, and embrocations, and the application of the dilute tincture of iodine. When the distension is inordinate, or threatens to eventuate in gangrene, early punctures and even free incisions are called for. In œdema of the glottis nothing short of prompt and decisive scarification will prevent suffocation.

SECT. III.—LYMPHIZATION, OR FIBRINOUS EXUDATION.

Lymphization is the act of separating lymph from the blood and depositing it into the organs and tissues, or upon their free surfaces. The term, which I was the first to introduce into science, has been objected to, on the ground, as is alleged, that it is not well chosen, because the word lymph is given to the fluid contained in the lymphatic vessels. I can perceive no reason, however, why it should not be retained and generally adopted, for it is certainly quite as appropriate and classical, in reference to the substance which it serves to designate, as the word suppuration is in relation to pus, which is the product of that act. I am the more inclined to this view, seeing that the word "lymph" is still in general use, notwithstanding the attempts that have recently been made to discard it by substituting the term "plasma," which is, if possible, still more objectionable. Perhaps the least obnoxious term is "fibrin," which is now also much in vogue, and which is expressive of at least one of the most important attributes of that substance, namely, its chemical constitution. The phrase "plastic matter" would be very appropriate, were it not that it is too circuitous for easy use.

There is rarely any inflammation, however slight, in which there is not some deposit of lymph. Indeed, in many cases, and in certain situations, it constitutes almost the only product of the morbid action. Thus, in croup and peritonitis, the chief evidence of the existence of these diseases, after death, is the presence of lymph; in general, however, it is associated with other deposits, especially serum, which is often poured out along with it in large quantities. When the inflammation is at all severe, and particularly if it has already made considerable progress, there may be, in addition, puriform matter, pus, and even pure blood. Its presence, whether occurring singly or combinedly, is always, as a general rule, denotive of a higher grade of action than the mere effusion of serum.

The capacity of furnishing lymph, in inflammation, is possessed in different degrees by different organs and textures, depending upon the peculiarities of their organization. It is always, other things being equal, poured out most freely by the serous membranes, especially the pleura and peritoneum, by the cellular tissue, and by certain portions of the mucous system, as the faucial, laryngeal, intestinal, and uterine. Very little is effused, under any circumstances, by the fibrous membranes, the muscles and their tendons, the vessels, nerves, cartilages, and bones, except in cases of fracture and other injuries, when it is sometimes thrown out in great abundance. In the parenchymatous organs, the same diversity obtains in respect to this deposit as in the tissues, properly so called. In some, as in the brain, liver, and kidneys, it is usually supplied very sparingly, whereas, in inflammation of the lungs and spleen, it is often effused quite freely, leading to rapid solidification of their proper structure. Large quantities of lymph are sometimes exhaled during the progress of abscesses, many of which it serves to inclose in a distinct cyst, known as the pyogenic membrane.

The deposit of lymph generally begins soon after the inflammatory action, and often continues for an indefinite period, increasing and declining with the disease. It is surprising how soon it sometimes shows itself. From my experiments upon inferior animals, as well as from my observations upon the human subject, I have been led to believe that it generally begins much sooner than is commonly supposed. In 1841, I had occasion to see repeated proofs of this fact, while engaged in an elaborate series of experiments upon dogs, with a view of elucidating the nature and treatment of wounds of the intestines. I found, in many of these animals, that the bowels had become extensively adherent, not only to each other, but likewise to the walls of the abdomen, within the space of a very few hours after the operation. In the case of a gentleman whose abdomen I opened some years ago, on account of a twist in the small intestine, I ascertained that, although death happened at the end of four hours, nearly the whole peritoneum, visceral and parietal, was coated with a thin film of fibrin, of which hardly any traces existed anywhere at the time of the operation. In another case, that of a young lad, who died within nine hours after he had been shot in the side, the ball wounding the abdomen, diaphragm, and chest, large quantities of lymph were seen both upon the peritoneum and pleura. The flaps made in amputation become speedily glazed with fibrin, and a similar phenomenon is often witnessed upon incised wounds, the edges of which frequently adhere quite firmly within a very short time after the application of the dressings.

From the preceding facts, it may be concluded that the process of lymphization generally begins at an early period of the inflammation, and that, if the circumstances are at all favorable, it proceeds with great vigor. If the reverse, however, be the case, then it goes on comparatively slowly, or it may even fail entirely. Such an event will be most likely to happen in low and depraved states of the system, attended with an impoverished condition of the blood, and consequent lesion of the innervation.

Lymph, plasma, or fibrin, considered as an effect of disease, is a direct product of the vessels of the affected structures, the process by which it is elaborated being one of a vital character, analogous to, if not actually identical with secretion. No one, so far as I know, doubts this opinion, except Virchow, who maintains that this substance has an extra-vascular origin, or, in other words, that it is a local product of the tissues, on and in which it is found, being essentially composed of the material generated in the inflamed part itself through the changes in its condition. He denies that there is, in the usual acceptation of the term, any inflammatory exudation whatever; or, what is the same thing, he insists upon it that there is no real transudation from the blood-liquor. Time will prove whether this opinion is true or erroneous.

Lymph exhibits, when first effused, a whitish, pale straw, or opaline appearance, though occasionally it is somewhat reddish, from the admixture of hematin. In cases of protracted jaundice, I have occasionally found it of a pale-orange hue. It is of a soft, unctuous consistence, like hot glue, or a thin solution of starch, without smell, and of a faint saline taste. Its chemical constitution is fibrin, in union with albumen and serum. Immersion in alcohol renders it tough, and changes its color from white to buff.

Examined *microscopically*, lymph is seen to consist of numerous globules, of a spherical shape, nearly homogeneous, and about the $\frac{1}{2500}$ of an inch in diameter. Delicate fibrils, straight, parallel, and interspersed with innumerable granules, are also visible in it. It is derived directly from the blood by a process of secretion, and is identical with the buffy coat and the blood-liquor; possessing vital and organizable properties, and therefore capable of performing important duties in the economy. Being always deposited in a fluid state, it soon arranges itself in various forms; now as an amorphous mass; now as a tube, as in the larynx, and bowel; at one time as a lamella, and at another as a distinct band; its conformation being materially influenced by that of the organ, tissue, or cavity in which it is effused.

Lymph does not always exhibit the same appearances under the microscope any more than it does under the naked eye. In this respect it shares the same fate as other morbid products. I cannot, therefore, recognize the doctrine of an essential difference in the character of the effused substance, so strenuously maintained by some recent pathologists, believing, as I do, that this difference is entirely due to a difference in the state of the part and system in different individuals, localities, and grades of the morbid action. Corpuscular lymph, as it has been termed, differs from ordinary lymph only, or chiefly, in having a greater number of exudation globules, and less of healthy fibrin. Hence, it is generally met with in persons of deficient vital powers, with an impoverished state of the blood, and usually manifests a disposition to break down and become effete.

Fig. 7 displays a portion of recently-effused lymph, opaque, white-colored, friable, and magnified about 380 diameters, from an inflamed pleura. It is composed of globules, smaller molecules, and granular matter in a hyaline matrix. In the lower part of the figure the granules and molecules are shown as floating in serous fluid. In fig. 8, the structure of the effused matter is somewhat different. It forms, in fact, a sort of false membrane, magnified 500 diameters. Numerous corpuscles are seen, more or less globular, and having the character of primary cells; the intervening texture is formed of most delicate fibrils. A few minute granules are interspersed through the tissue.

Fig. 7.

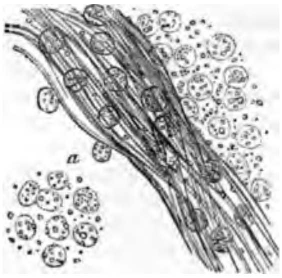


Fig. 8.

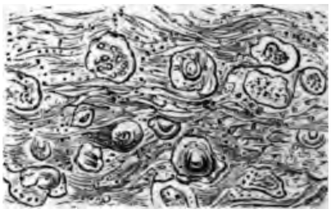


Fig. 7. Plastic corpuscles and filaments in recent lymph exuded on the pleura. *a*. The corpuscles, unchanged by acetic acid.
Fig 8. Recent lymph, forming false membrane.

The period at which the organization of this substance takes place varies with a number of circumstances, of which the most important are, the plasticity of the effused matter, the nature of the affected tissue, and the state of the general system. To enable it to attain this point at all it is necessary that it should have a strong cell-life, or cell-force; for when this is wanting the development of cytoblasts and nuclei is either impracticable, or it occurs so imperfectly as to be soon arrested, or, at all events, very much impaired. When everything is favorable, the development proceeds very rapidly; cells and nuclei are formed in great numbers, and these, connecting themselves with each other, are gradually spread out into fibres, lying, for the most part, in straight, parallel lines, and profusely inlaid with granules, as in fig. 9. Soon after this process has begun, vessels show themselves in the new product, either as an offspring of a new epigenesis, or as an extension from the neighboring structures, the latter being by far the more common source of the supply. The walls of the vessels are, at first, very frail and yielding, so that the least pressure is sufficient to rupture them and cause an extravasation of their contents. Gradually, however, as they increase in age, they become better qualified for the discharge of their functions, and in time acquire all the properties of the natural vessels. When fully developed, they can be easily discovered with the naked eye, and readily admit fine injecting matter. The veins are usually disproportionably large to the arteries, but this defect also ultimately disappears. Nerves and absorbents likewise exist,

Fig. 9.

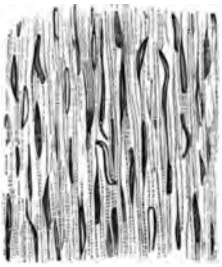


Fig. 10.

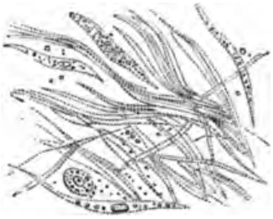
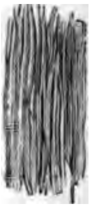


Fig. 11.

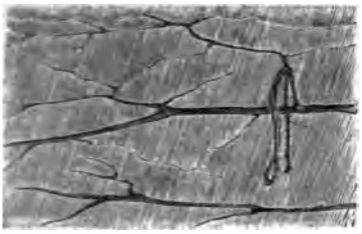


Figs. 9 and 10, from Bennett, show nuclei and cells developing themselves into fibres: whilst fig. 11 exhibits a perfect fibrous tissue.

but whether they are supplied by the surrounding tissues, or by the inherent powers of the effused matter is undetermined.

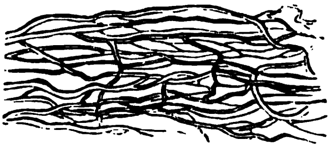
The arrangement of the newly-formed vessels is represented in the annexed sketches. Fig. 12 is a portion of coagulating lymph attached by a narrow neck to the peritoneal coat of an inflamed intestine. The vessels have a ramiform disposition, and freely anastomose with each other. Fig. 13 is a piece of false membrane of the pleura. The vessels are large, numerous, and farther advanced than in the other sketch.

Fig. 12.



Newly-formed vessels in plastic lymph.

Fig. 13.



Vessels in false membrane of the pleura.

There are some situations where fibrin is never organized, however strong its vitality may be at the moment of its deposition. Such an occurrence, for example, is nearly always impossible in the alimentary canal and urinary bladder, for the reason that the irritating and heterogeneous contents of these reservoirs speedily deprive the lymph of its organizable properties. Site, then, exercises an important influence upon the process, which, it may be added, is also materially affected by the state of the blood and solids; the more feeble and impoverished these are the less likely will the effused substance be to form cells and nuclei, vessels, nerves, and absorbents.

Lymph is susceptible of absorption both in its fluid state and after it has been changed into blastema and fibro-cellular tissue. This, however, does not occur, at least not to any extent, during the height of the inflammation, by which it has been produced; on the contrary, there must always be a marked reduction of the morbid action before the absorbent vessels can be induced to take hold of it; but when this point has once been reached, the process often goes on very rapidly, as is witnessed in fractures, dislocations, wounds, and other injuries, in which the swelling, chiefly caused by fibrinous deposits, occasionally completely vanishes in a few days. The absorption will of course be more difficult when the lymph has become organized, when, in fact, it not unfrequently effectually resists all the efforts that the surgeon can employ to get rid of it. The opaque spot on the cornea often remains despite of the most protracted treatment. It is probable that lymph, before it can undergo absorption, even in its liquid state, is broken up and dissolved in the fluids of the affected parts; being thus brought more readily under the influence of the vessels.

Moreover, lymph is susceptible of various kinds of degeneration, both in its early and in its more advanced stages, just like other deposits and formations. When recently effused, it may be converted into pus, especially when it is aplastic and exposed to the air; under which circumstances it also frequently becomes hard, dry, and shrivelled, losing its vitality, and assuming the character of an effete substance. It also undergoes fatty degeneration, both before and after vascularization; and, finally, there are cases in which it becomes the seat of pigmentary deposits.

1. USES OF PLASTIC MATTER.

The uses of coagulating lymph in the repair of disease and injury were very imperfectly understood by the older surgeons, and hence it is not difficult to account for their erroneous principles of treatment. A few only had any correct notions on the subject, which, however, strange as it may appear, they rarely applied in practice. Taliacotius, although he knew how to reconstruct mutilated parts, by the transplantation of integument from one region of the body to another, seems never to have thought of applying the knowledge thus acquired to the reunion of accidental wounds. Instead of approximating their edges and keeping them together for a certain period, to insure their adhesion, the older surgeons not only allowed them to gape, but took great pains to irritate and inflame them, thinking thereby to rid the part and system of noxious humors. No person with such an injury was deemed safe until the parts had passed through a process of mundification, suppuration, and incarnation. To treat them otherwise would, in their judgment, have subjected them to great hazard, on account of the supposed retention of peccant matter. An opportunity must be afforded for the escape of this matter, and the period consumed in this delusive treatment often extended through several months even in the most insignificant cases. Wounds which, if properly managed, would have healed in a few days, were thus often kept open for an incredible length of time. This practice, so prejudicial to the true progress of surgery, and so utterly at variance with the best interests of humanity, continued in vogue until the time of John Hunter, towards the close of the last century. It remained for this illustrious man to point out the properties of plastic lymph, and to describe its many surgical uses. Through his influence a happy revolution has been effected in the treatment of wounds and other injuries, as well as in the various plastic operations, the beneficial effects of which cannot even yet be fully estimated.

The modern practice in the treatment of wounds is, as soon as all oozing of blood has ceased, to approximate their edges by appropriate dressings, and to retain them in this position for a sufficient length of time to insure their reunion by the organization of the plasma that is effused between them. But little inflammation is required for the process, and hence the chief duty of the surgeon consists in keeping the parts cool, elevated, and at rest. The great danger is in doing too much, thereby thwarting nature's efforts at repair. All heating and stimulating applications are out of the question, as so many impediments to the desired action; the mind and body are kept free from excitement, and the strictest attention is paid to the bowels, diet, and secretions; under this management the wound generally heals in a few days, the bond of union becoming hourly firmer and firmer until it is as perfect as nature can make it by the conversion of the plasma into fibro-cellular matter, of which, however, very little is ordinarily left when the process is completed.

Parts completely separated from each other, and immediately replaced, will, if judiciously managed, often reunite, and be nearly, if not quite, as useful as before. Numerous cases, of a well-authenticated character, are upon record of bits of fingers, the nose, and the ear having been successfully treated in this wise.

It was upon a knowledge of the plastic properties of coagulating lymph that Taliacotius founded his world renowned operation, which is now universally known by his name, of repairing mutilated noses, lips, and ears. His attention was originally directed to the subject by watching the effects of the grafting of trees; he observed that the transplanted portion not only contracted firm adhesions in its new situation, but that it generally grew with great vigor, and ere long produced most excellent fruit, altogether superior to, and different from that of the parent stock. Possessed of a profoundly inventive genius, he was led to believe that a similar operation might be performed upon man, and it was not long before he put his reasoning to the test of experiment. His success was complete, and the result was that he became the great rhinoplastic surgeon of his day. His method consisted in raising a flap of integument from the arm, and after having thoroughly pared the mutilated organ, in sewing the raw edges accurately together, care being afterwards taken to maintain the parts in contact with each other until they had become closely and inseparably united. The Indian method, as it is termed, differs from that of Taliacotius mainly in this, that the flap of skin is generally borrowed from the immediate vicinity of the deformed organ, its pedicle being twisted upon itself in such a manner as not to interfere injuriously with its circulation.

Du Hamel, near the middle of the eighteenth century, executed some curious experiments, which, as having a direct bearing upon the present subject, deserve passing notice, notwithstanding they are old and trite. They consisted in ingrafting the spur of a cock upon the comb of the same animal, where, especially if the spur was a young one, it generally promptly united. In one instance he found that the spur, although not larger than a hemp-seed when the operation was performed, acquired in the course of from three to four years a length of several inches. The experiment was subsequently repeated by John Hunter with similar results. He ascertained not only that what Du Hamel had said was perfectly true, but that, if the testicle of a cock be transplanted into the abdomen of a hen, such complete union will occur between them as to permit minute injecting matter readily to pass from the vessels of the one into those of the other.

The fact that a tooth, extracted by mistake, will, if immediately replaced in its socket, speedily reunite, and ultimately regain its former hold, has long been familiar to dentists. It was formerly supposed that the adhesion was always imperfect, but that this is not so is shown by the circumstance that the vascular connection between the tooth and the socket may be demonstrated by injection. The knowledge of this fact led to the painful and disgusting practice, so much in vogue in the last century, of transplanting teeth from the mouth of one person into that of another, and which was finally abolished only when it was discovered that it was fraught with danger, on account of its liability to transmit disease.

Finally, there is, as an additional illustration of this interesting subject, the singular experiment of John Hunter of inserting a fresh human tooth into the comb of a cock, where it took root, and became firmly fixed, new vessels extending up into the cavity of the fang, as was ascertained by injection after the death of the animal.

Curious and instructive as the above experiments are, they hardly equal, in point of interest, many of those that have been performed by the modern surgeon upon the human subject for the relief of mutilated structures. Whether science has attained its highest triumphs in the department of plastic surgery, or whether it is capable of still further achievements, time alone can determine.

The good effects of plasma are exhibited in various other processes, as in the suppression of hemorrhage, and the radical cure of hernia. In the former, the patient would inevitably bleed to death if it were not for the agency of lymph in sealing up the mouth of the vessel by attaching the internal clot firmly to its surface. In hernia a radical cure can only be effected through the intervention of plastic matter, thrown out in consequence either of the pressure of a well-adjusted truss, or the injection of some irritating fluid, causing inflammatory action in the parts around.

Plastic matter is often of service in circumscribing morbid action, and in inclosing foreign bodies. In abscess a wall of lymph is generally formed around the pus, effectually preventing its diffusion among the surrounding tissues. Occasionally the fluid is inclosed by a distinct membrane, derived from the fibrin of the blood, and possessed of a high degree of organization. In carbuncle and erysipelas the lymph is usually of an aplastic nature, and therefore incompetent to prevent the extension of the disease. Balls, needles, pins, and various other foreign bodies are occasionally inclosed in a manner similar to pus, and, in consequence, often remain harmless tenants of the body for many years.

Again, plasma is of service in obviating accidents. Thus, in abscess of the lung, if it were not for the intervention of the fibrin of the blood, the matter would often break into the cavity of the chest, and destroy life in a few days, if not in a few hours. How then is this untoward occurrence prevented? Simply by the development of inflammation in the pulmonary pleura, followed by a deposit of lymph, which thus becomes the bond of adhesion between this membrane and the costal pleura; so that by the time the matter reaches the surface an effectual barrier is opposed to its effusion, in consequence of which it generally discharges itself through a contiguous bronchial tube. A similar occurrence takes place in abscess of the liver in relation to the peritoneum and intestinal tube. In typhoid fever the glands of Peyer are often perforated, and yet it seldom happens that the contents of the bowel escape into the abdominal cavity, simply because of this wise provision of nature in gluing together the contiguous serous surfaces.

Finally, lymph is of use in obliterating serous cavities. In the radical cure of hydrocele, a disease which has its seat in the vaginal tunic of the testicle, an operation is performed which has for its object the establishment of a certain degree of inflammation, followed by a deposit of fibrin, just sufficient to cover the opposing surfaces, and to insure their permanent agglutination. Serous cysts are treated upon similar principles; and modern surgery has been emboldened to inject even some of the movable joints, the abdomen, and ovarian tumors with irritating fluids, for the radical cure of dropsical diseases of these parts.

2. INJURIOUS EFFECTS OF PLASTIC MATTER.

But lymph is capable of producing injurious effects as well as beneficial; nature's operations cannot always be controlled by art, and it is therefore not surprising that she should often overleap the bounds of discretion when she is depleting the inflamed structures by effusion of plastic matter. Immense mischief is frequently done in this manner, within a few hours after the commencement of the morbid action; mischief which it may require months of the most judicious and persevering efforts of the surgeon to eradicate. Examples of this occurrence are daily met with in practice, and serve as mortifying illustrations of the impotency and imperfection of our art, as well as of the perverseness of disease.

Among the more common and obvious effects of this description are the following: 1. Mechanical obstruction of the natural outlets of the body. 2. Change of structure by interstitial deposits. 3. Abnormal adhesions. 4. Induration and enlargement.

a. An example of *mechanical obstruction* from a deposit of lymph is afforded by what occurs in the windpipe in plastic croup, the principal anatomical character of which is the formation of a false membrane, which often moulds itself accurately to the shape of the tube, and which, especially when it extends high up into the larynx, may become a source of suffocation by impeding the entrance of the air into the lungs. In rare cases the membrane is detached and expectorated; but generally it remains in spite of our remedies, and speedily destroys the patient. Not even an artificial opening into the trachea will usually avert this event.

In some of the mucous canals this matter is poured out beneath the lining membrane instead of upon its free surface, where, becoming organized, it leads to permanent contraction of the tube. It is in this manner that stricture is formed; when the case is a very bad one, lymph may also be effused into the substance of the lining membrane, and even upon its free surface, as is seen in what is called the bridle-stricture of the urethra, which, however, is exceedingly rare.

b. Change of structure by *interstitial deposit* of lymph occurs in almost all cases of inflammation, however slight or however situated. In pneumonitis, it closes up the air-cells and minute bronchial tubes, as well as the cells of the connective areolar tissue, producing what is called hepatization of the lungs. Opacity of the cornea, acting obstructingly to the rays of light, is the invariable result of a deposit of plastic matter either beneath its conjunctival covering or in its inter-lamellar structure.

c. *Abnormal adhesions*, wherever found, are occasioned by this substance, thrown out as a consequence of inflammatory action. The effects of such adhesions are always more or less prejudicial. In the thoracic cavity, they confine and restrain the play of the heart and lungs; in the abdomen, they often become a source of internal strangulation; in the mucous outlets, as in the vagina and uterus, they may produce complete occlusion of their orifices; and in the vessels, especially the arteries, they sometimes induce obliteration of the largest sized trunks. Abnormal adhesions between the bowel and the sac in hernia are sometimes a cause of its irreducibility.

Great mischief is often done by deposits of lymph into the joints. If the matter be not promptly removed by the absorbents, nature makes an effort to organize it, and to convert it into an adventitious structure, which, undergoing various mutations, at length assumes the properties of the osseous tissue, at the same time that it effectually destroys the motions of the articulation. The case, in fact, is one of bony anchylosis, and no treatment that can be brought to bear upon it will be of any avail in regaining the functions of the part.

d. Among the more frequent and distressing evils of plastic deposits are *induration and enlargement*, or hardening and thickening of the organs and tissues. Such occurrences are generally exceedingly annoying, often severely taxing the patience of the sufferer and the skill of the professional attendant. They are the direct result of interstitial deposits, which often manifest an early tendency to organization and transformation, and which none but the most determined perseverance in the use of remedies can enable us ultimately to overcome. The stiff and thickened joint, the indurated and enlarged testicle, the hypertrophied spleen, liver, and lymphatic gland, the hardened and enlarged tonsil, are literally living witnesses to the truth of this statement.

TREATMENT.

The treatment of lymphization is to be conducted upon general antiphlogistic principles; undue action is to be repressed, and the absorption of effused matter is to be promoted. To accomplish the first of these objects, the ordinary local and constitutional measures are employed; for the second, sorbefacients are necessary, as mercury and iodide of potassium internally, and the tincture of iodine, liniments, and embrocations externally. In the acute stage of the disease, while secretion is still active, purgatives and antimonials, with the liberal exhibition of calomel, constitute the chief means of relief; but the tendency to deposit having ceased, their use is dispensed with, all except the mercury, which is now given in minute doses, and with a view strictly to its alterative effect; it is often carried to slight ptyalism, the mouth and gums being maintained in a tender condition for perhaps several weeks consecutively; or, with an occasional interval, for even a much longer period. In the latter event, the bichloride frequently, if not generally, forms a valuable substitute for the calomel; less likely to act hurtfully, and yet, at the same time, very effectually stimulating the absorbents. In such cases, too, small doses of tartar emetic often produce a most salutary influence; its action being hardly inferior to that of mercury itself, with which it may frequently be advantageously combined. When the inflammatory action has pretty much subsided, its products, especially the serous and plastic, are generally easily gotten rid of by hydrochlorate of ammonia, or iodide of potassium, administered in doses varying from three to twenty grains, in aqueous solution, three times in the twenty-four hours; strict attention being paid, meanwhile, to the diet and bowels. When the case is obstinate, an occasional mercurial will constitute a valuable addition.

Among the more beneficial topical means are, the dilute tincture of iodine, applied twice in the twenty-four hours; inunctions with mercurial and other unguents, particularly that of the iodide of lead; stimulating embrocations; and steady, uniform support with the bandage. Various kinds of plasters, as the common mercurial, the compound galbanum, and others of a kindred nature, are also frequently serviceable. Washing the part well, when accessible, twice a day with hot water and Castile soap, and then using dry friction upon it, often do more good than anything else. In some cases, again, cold, especially in the form of the douche, acts very beneficially, affording relief when everything else seems to fail. In the case of the joints passive motion must be carefully performed, at first once, and then twice a day, to prevent anchylosis from the organization of the fibrinous bands which are so liable to form during the progress of synovitis.

When the object is simply to assist nature in her efforts at repairing injury, as a wound or fracture, care should be taken, on the one hand, that the attendant action is not too low, and, on the other, that it does not transcend the fibrinizing limits. By over-officiousness the system may be so exhausted as to render the proper supply of lymph in the part a matter of impossibility, or such a state of the constitution may be brought about by the effects of previous disease, intemperance, or inadequate nutrition from the want of proper food. However induced, it should claim prompt attention, every effort being made, by the use of tonics, stimulants, and other invigorating measures, to supply the blood with the requisite material for the deposition of fibrin; all debilitating topical applications being at the same time discontinued. Over-action, on the contrary, is met by the usual antiphlogistic means, carefully and warily applied, lest harm should result from the too rapid reduction of the vital powers. The management of the reparative process always demands great judgment and vigilance.

SECT. IV.—SUPPURATION AND ABSCESS.

Suppuration is the process by which pus is formed, and is one of the most frequent, as it is certainly one of the most important, of the results, events, or conditions of inflammation. Its presence, as a general rule, is denotive of a higher grade of excitement than a mere deposition of serum and plastic matter, which, however, are nearly always associated with it. But it must not be supposed that the reverse of this proposition is true; for inflammation often exists in a severe degree, with an abundant effusion of the watery and fibrinous elements of the blood, and yet there is not the slightest evidence of suppuration.

It was formerly supposed that suppuration might occur without the agency of inflammation, and there seems to be still a lingering disposition on the part of some pathologists to adhere to this doctrine, if not by direct advocacy, at least by implication. The opinion doubtless had its origin in the fact that there are occasionally cases of suppuration in which large quantities of pus are thrown off, without any evidence of the ordinary phenomena of inflammation, such, especially, as pain, heat, and discoloration of the structures in which the matter is formed, or any constitutional disorder; the whole process being apparently conducted as if both the part and system were unconscious of what is going on. Such cases are by no means infrequent, and yet if they be carefully investigated, or traced through the various stages of their progress up to the dissection of the affected tissues, the most satisfactory proof will be afforded of their phlogistic nature. In a cold, strumous or scrofulous abscess, for example, which has so often served as the basis for this, now nearly exploded idea, and the formation of which is sometimes the work of several months, inflammation is just as much concerned in the production of its contents, as in a phlegmonous boil that is developed in three or four days. The only difference is, that in the one the morbid process moves on slowly and almost imperceptibly, while in the other it proceeds very rapidly, and is accompanied by such well-marked symptoms as to render it impossible to mistake their character.

Pus may be formed, as is well known, without any breach of continuity of the affected parts. This mode of suppuration is, in fact, very common, not only in the serous cavities, but throughout nearly the whole of the mucous system. It is not, however, confined to these textures. In the cellular substance, lungs, brain, liver, and other viscera, nothing is more frequent than suppuration, without any ulceration whatever in the inceptive stages of the morbid action.

The formation of purulent matter does not take place with equal facility in all the organs and textures. Of the viscera, those which are most prone to take on suppurative action are the liver, lungs, and brain; of the tissues, the cellular, cutaneous, mucous, and serous. In the fibrous, cartilaginous, tendinous, and osseous textures, this fluid forms with difficulty, and is seldom of a thick, consistent nature. Of the mucous system some portions are more liable to be affected with suppuration than others. Thus, it is much more common to find pus in the colon than in the stomach or ileum, in the vagina than in the uterus, in the urethra than in the urinary bladder, in the nose than in the mouth, in the fauces than in the œsophagus, in the bronchia than in the larynx. So, likewise, in the serous system, suppuration is more frequent in some situations than in others; as, for example, in the pleura, the vaginal tunic of the testicle, and the lining membrane of the larger joints In the subcutaneous cellular texture, pus is most readily formed in those parts which are remote from the central organ of the circulation. The blood-vessels do not often suppurate, except when wounded; and the same, so far as we know, is the case with the absorbents. The lymphatic ganglions, however, are very frequently affected in this way, especially those of the axilla, the groin, the mesentery, and the base of the lower-jaw, particularly in persons who are predisposed to scrofulous disease. The nervous tissue seldom suppurates, and the muscular still more rarely. From all these facts we may deduce the axiom, that those structures are most prone to form matter which contain the largest amount of loose cellular substance, and, conversely, that those which possess this tissue sparingly always suppurate with difficulty, requiring in general a much longer period, and elaborating a less perfect fluid.

The period at which suppuration may occur after the establishment of inflammation varies, on an average, from twenty-four hours to three or four days, depending upon the nature and situation of the affected tissues, the intensity of the morbid action, and also, and that in a material manner, upon the condition of the system, and the character of the exciting cause. Mucous membranes, especially if exposed to the air, generally suppurate very readily, having, as it were, a predisposition to take on this kind of action; serous membranes, on the contrary, suppurate with difficulty, one reason of which is that, being arranged in the form of shut sacs, they do not feel the stimulus of the atmosphere; another, doubtless, is the fact that such structures, when irritated, are naturally inclined to furnish lymph rather than pus, their organization peculiarly fitting them for that office. The same difference exists between the veins and arteries, and it is practically fortunate that it does; otherwise the danger of wounds, whether the result of accident or design, requiring the ligation of the principal arteries, would be much greater than experience has shown it to be. No surgeon likes to tie a large vein, well knowing that the operation may be followed by fatal suppuration of its lining membrane. In some of the internal viscera, as the brain and liver, pus sometimes forms with great rapidity, as is seen in cases of injuries of these organs. Matter, other things being equal, forms more rapidly when the inflammation is very intense than when it is comparatively mild. A wound inflicted upon an unhealthy or intemperate person will be more likely to run speedily into suppuration than one of a similar character occurring in an individual of sound constitution and regular habits. A phlegmonous boil will usually begin to deposit pus in from twenty-four to thirty-six hours, whereas a chancre does not furnish any, so far as we are able to judge, until the beginning of the fourth day. In variola, the suppurative process is generally not fully established until about the ninth day.

Exposure of an inflamed surface to the air greatly promotes suppurative action, and is, consequently, directly hostile to adhesion. The more nicely the edges of a wound are approximated, the greater, all other things being equal, will be the probability of speedy and permanent reunion, and conversely. Serous membranes, as already stated, have naturally a disposition, when inflamed, to pour out lymph, and become glued together; but whenever they lose the character of closed sacs, as they necessarily do when they are accidentally opened, the morbid action, consequent upon the injury, is certain to be followed by the formation of pus, especially if the air is permitted to have free access to them for any length of time.

Pus originally appears in the form of distinct globules, which are dispersed through the affected structures, and can be easily recognized by their pale yellowish color. As the purulent particles increase in number, they gradually become confluent by the removal of the parts concerned, and in this way the matter is at length collected into an abscess.

The symptoms which characterize the suppurative process will claim special attention when we come to speak of abscesses. Meanwhile, it will suffice to observe, in general terms, that they are such as denote the existence of ordinary inflammation, with an increase, more or less considerable, of the local and constitutional disturbance.

Pus, the product of suppuration, has been an object of anxious study from the earliest ages of the profession down to the present time; but it has only been within a comparatively recent period that any real and reliable light has been thrown upon its physical, chemical, and microscopical properties.

When genuine, or, as it is not unaptly termed, good, healthy, or laudable, pus is of a white, yellowish tint, opaque, homogeneous, of a sweetish taste, without any particular smell, and of the consistence of thin cream. It is heavier than water, in which it is partly dissolved, emits a faint, mawkish odor on being heated to the natural temperature of the body, resists putrefaction with remarkable pertinacity, and is coagulated by heat, alcohol, and hydrochlorate of ammonia. Pus freezes less rapidly than water, and when thawed does not regain its original properties.

The specific gravity of pus is liable to considerable variation. It is less than that of blood, and greater than that of serum. According to Gueterbock, it ranges from 1030 to 1033. In seven distinct examinations of pus, taken from abscesses in different situations—as the thigh, arm, axilla, back, pleura, and the lung in pulmonary phthisis—Dr. John Davy found the specific gravity as low in one as 1021, and in another as high as 1042. This great disparity is mainly attributable to two circumstances, the unusual quantity of the solid ingredients, and the variable density of the liquid part.

The *chemical* constitution of pus has been examined by a great number of experimentalists, and the results of their investigations tend to show that it contains most of the elements of the blood. The following analysis is by Gueterbock, from the pus of an abscess in the human breast.

Water	86.1
Fat, soluble only in boiling alcohol	1.6
Fat and osmazome, soluble in cold alcohol	4.3
Albumen, pyine, pus globules and granules, soluble neither in hot nor in cold alcohol	7.4
Loss	0.6
	100.0

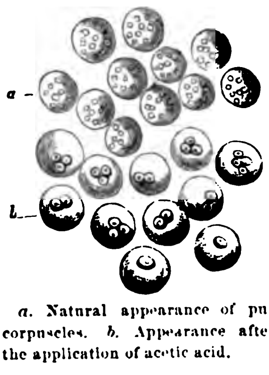
Lehmann has investigated the chemical composition of the different elements of pus with great care. Normal pus he found to contain from 14 to 16% of solid constituents, of which from 5–6% belonged to mineral or inorganic substances. The most usual insoluble salts of pus are the phosphates of lime and magnesia, and the sulphate of lime; the principal part of the soluble salts is furnished by chloride of sodium. The quantity of fat was found to vary from 2–6%; the quantity of albumen in the serum from 1.2 to 3.7%. Casein and the coloring matter of the blood do not occur in normal pus. A substance which usually enters into the composition of pus is *pyine*. Gueterbock, who discovered it, considers it as a peculiar animal principle. Its exact nature is not understood. It is supposed by some to be an oxide of protein, by others a form of fibrin. It can be precipitated from pus by acetic acid, or by alum. It is soluble in water, but insoluble in alcohol.

Pus occasionally contains a peculiar substance, denominated *pyocyanine*; it imparts a bluish or greenish hue to the contents of certain abscesses, and to the discharges of certain ulcers, but its real nature is not well understood.

With regard to the composition of the compound part of the pus globules we possess no positive knowledge. The cell walls, contents, and nuclei, react like protein bodies, and are probably of an albuminous nature. The cell walls are dissolved by acids, but resist the action of alkalies.

Pus, *microscopically* examined, is found to be composed of numerous small corpuscles suspended in a thin, transparent fluid, called the pus-liquor. These little bodies, which have received the name of pus globules, are generally of a spherical form, and vary in size from the $\frac{1}{2000}$th to the $\frac{1}{3000}$th of an inch in diameter. They are mostly very granular, and possess a delicate cell wall, which becomes distinct on the addition of water. They

Fig. 14.



a. Natural appearance of pus corpuscles. *b.* Appearance after the application of acetic acid.

are nucleated; some containing one well-defined nucleus, others two, three, or more small nuclear bodies. Acetic acid has the effect of rendering them apparent; the cell-contents and wall becoming transparent under its influence, especially if the acid be undiluted. Fig. 14 exhibits pus corpuscles in their natural state as well as their appearance when acted upon by acetic acid.

These corpuscles float in the pus-liquor, and are intermixed with various other solid elements, as granules, shreds of fibrin, and exudation corpuscles; also, at times, with small homogeneous, non-nucleated corpuscles, termed pyoid.

Pus is liable to be modified in its properties by the presence of extraneous substances, such as grumous blood, fibrin, cholesterine, and the debris of the organs and textures in which it is formed. In common phlegmon, it often contains shreds of cellular tissue, of a dirty grayish color, not unlike wet tow. The brownish matter found in certain abscesses of the liver probably derives its color and consistence from the intermixture of the softened and broken-down hepatic parenchyma. In suppuration of the different glands, the pus is not unfrequently mingled with the product of their secretion. Thus, in the kidney, it may blend itself with the urine, in the liver with the bile, in the mamma with the milk, in the testicle with the semen. Purulent matter is sometimes very fetid, probably from the extrication of sulphuretted hydrogen.

The different varieties of pus have received different names. When the fluid is of a whitish color, creamy in its consistence, and composed of a great number of globules, it is said to be *healthy*, pure, or laudable, in reference to the process by which it is produced, which is of a healthy, sanative, or restorative nature. It is usually met with in suppurating wounds, in healing ulcers, and in phlegmonous abscesses. Its properties have already been sufficiently described.

Sanious, serous, ichorous, or sanguinolent pus is thin, almost transparent, of a yellowish, oily, or reddish color, and generally so acrid as to erode the parts with which it comes in contact. It is a product of unhealthy inflammation, and is principally observed in caries of the bones, in irritable ulcers, and in open cancer. This variety of pus is frequently blended with grumous blood, flakes of fibrin, and the debris of the affected tissues.

Fibrinous pus consists of common pus in combination with lymph. It is of a whitish, grayish, or cineritious color, and of a semi-liquid, concrete, or lardaceous consistence. Under the microscope, it displays the globules of healthy pus, with numerous other cells and fibres of irregular shape. It is commonly found in the joints, the splanchnic cavities, in metastatic abscesses, and in carbuncular inflammation. Its presence denotes a high degree of morbid action.

Scrofulous pus is mostly seen in pulmonary caverns, cold abscesses, scrofulous disease of the joints, and chronic inflammation of the lymphatic ganglions. After standing a little while, it usually separates into two parts, of which one is thick, straw-colored, and inodorous; the other, which rests on the surface, thin, ropy, and mixed with small, opaque, curdy flakes. When scrofulous pus is long retained it may acquire a disagreeable, nauseous smell, not unlike the pollen of the chestnut; at other times it is excessively fetid. The attendant action is usually very languid.

There is a variety of pus to which, from its admixture with mucus, the term *muco-purulent* is applied. It is usually a product of a high degree of inflammation of the various outlets of the body, particularly the nose, eye, bronchial tubes, and genito-urinary apparatus. The mucus which proceeds from these surfaces in the healthy state is composed of a transparent fluid, and of abraded epithelial cells, flat, and irregularly sided with a central nucleus. In addition to these, the microscope detects numerous granular masses and spherical globules, similar to those of pus; the whole being suspended in a viscid, transparent, ductile fluid. Under inflammation, the epithelial cells are cast off so quickly that they have not time to become flattened out, and the globules are not only greatly augmented in number, but they acquire somewhat the character of those of pus.

Finally, there is what is called *puriform* matter, a substance which, as the name implies, is not true pus, but an imperfect liquid bearing some resemblance to it. It is found chiefly in bad forms of inflammation, as erysipelas, carbuncle, and pyemia, and consists essentially of broken-up lymph and shreds of tissue, interspersed with fatty substance, granules, abortive cells, and a few globules, smaller than those of pus, and not affording the usual reaction under acetic acid.

Certain kinds of pus, as those, for example, of smallpox, varioloid, gonorrhœa, and chancre, are *contagious*. In what particular element of the fluid the virus or specific secretion is contained, or whether it exists as an entity, is undetermined. The vitality of the organ by which it is elaborated is not necessary for the preservation of its peculiar effects. Once formed, it becomes independent of its source, and retains, for a considerable period, the power of contaminating the parts to which it is applied, producing a disease of the same character. Various chemical agents, however, as the alkalies and acids, have the property of neutralizing or destroying it, so that, if innoculation be afterwards attempted, no effects will follow. If the pus of a chancre be examined with the microscope, it will often be found to contain animalcules, particularly the vibrio lineola.

Pus was formerly supposed to be a product of secretion, an operation similar, in principle, to the secretion of bile and other fluids. This opinion, however, is no longer tenable, modern researches having shown that it is merely altered coagulating lymph, fibrin, or plasma, so abundantly effused during the inflammatory process, especially at the focus of the morbid action. In what manner, or by what agency, the change is effected, is not determined. All that is certainly known concerning it is that the pus corpuscles resemble, in their size, shape, and structure, the corpuscles in the effused lymph, and that the former always contain more or less oily matter, which thus constitutes one of their characteristic features. Leaving, then, out of the question any speculation in regard to the subject, it is evident that the fluid, called pus, is formed externally to the vessels by a species of disintegration and decay of the plastic elements of the blood, thrown off as an effect of inflammation, and that, consequently, secretion has no agency whatever in its production.

Pus globules are, as has already been seen, nucleated cells which have their origin in germs that pre-exist in the effused lymph, but which are not fully developed until they have been subjected to a species of metamorphosis, the precise nature of which has not been explained. The change is probably partly of a vital, partly of a chemical nature; or, possibly, it may be mainly of the latter description, the peculiar color, form and size of the pus globules being dependent upon transformation effected in the exudation. Rokitansky has advanced the idea that the pus corpuscles may change, by a kind of exogenous process, if not also by an endogenous one, into granule cells; a view which seems to me neither plausible nor consistent with the established doctrine of ordinary cell formation. No development of this kind can occur without the agency of the vital principle, and it is hardly possible to conceive that a pus globule should be so endowed after it has attained its full growth. Rokitansky also supposes that the fluid in which the corpuscles are suspended may give rise to a large amount of oily matter.

The more aplastic or degraded lymph is, at the moment of its deposition, the more likely will it be to be transformed into pus; hence what has been called corpuscular or croupous lymph is much more prone to assume this character than the fibrinous, or more organizable variety of this product. The degeneration is also, no doubt, materially influenced by the softened and disintegrated condition of the affected tissues, in the meshes of which the lymph is situated, such a change being highly favorable to the development of pus germs, or, what is the same thing, inimical to the production of healthy blastema.

Pus is susceptible of absorption, probably in all its varieties, as well as in almost every locality. Satisfactory proof of this fact is afforded by what occurs in abscesses in the different external parts of the body; and it is therefore analogically reasonable to infer that it may also take place in the internal organs and cavities. Great doubt has recently been expressed, especially by some of the French pathologists, respecting the possibility of pus being taken up in this manner, on the ground, chiefly, that the accumulations which occasionally disappear, both spontaneously and under treatment, are really not abscesses, but collections of plastic matter. Every surgeon, however, of experience knows that pus, or puriform fluid, is sometimes removed by the agency of the absorbents, after its existence has been satisfactorily tested by the exploring needle. Particular remedies are often employed for the attainment of this object, and our efforts are certainly not unfrequently crowned with success, although probably not as often as is generally supposed.

Pus, as pus, is never absorbed. It is extremely probable that the thinner parts are at once carried into the system, without any previous change; whereas, the pus globules are no doubt obliged to undergo a species of degeneration and disintegration, before they can be acted upon by the absorbent vessels. Whether the fatty matter remains, or whether it, also, is removed, has not been determined. How pus is disposed of, after it has reached the circulation, is likewise unknown; but the most reasonable conclusion is that it undergoes oxidation, and is excreted by the liver and kidneys, if not, also, by some of the other emunctories.

ABSCESSES.

An abscess is a circumscribed cavity of abnormal formation, containing pus. When the matter is poured out into a natural cavity, as the chest, or within a joint, the collection constitutes what is called a purulent effusion. An abscess may be superficial or deep, acute or chronic, common or specific. An abscess is said to be superficial when it is immediately beneath the common integuments or in the cellular substance among the superficial muscles. The word deep, on the contrary, is used when the matter is lodged in an internal organ, in the substance of a bone, or among muscles, bound down by a large quantity of tissue. The terms acute and chronic have reference merely to the time occupied in the formation of the abscess. A common abscess is one produced by ordinary inflammation; while the specific abscess is the result of the operation of some particular poison, as the virus of chancre, smallpox, or glanders. Finally, an abscess is circumscribed, as when it is bounded by plastic matter; or diffuse, as when its contents are sent abroad through the connecting areolar tissue.

The most philosophical division of abscesses is into phlegmonous, scrofulous, and metastatic, the first being incident to all persons, while the second is capable of occurring only in certain classes of individuals, or such as are affected with a strumous taint of the system. The term "metastatic," formerly so much in vogue, is employed to designate those collections of pus which are consequent upon severe injuries, operations, and diseases, and might be advantageously abolished, as it is only calculated to convey false impressions respecting a form of suppuration which properly comes within the definition of phlegmonous, although, as will be shown by and by, it is generally supposed to have its origin in a toxical condition of the blood. It has recently been described under the term "multiple," and will claim particular attention under the head of pyemia. It is not easy, in the present state of the science, to assign an appropriate place to the diffuse abscess, as it is often impossible to determine its real character. The specific abscess will not require any special consideration, since, apart from its exciting cause, its mode of formation does not, so far as we are able to comprehend it, differ at all from that of the common phlegmonous abscess.

1. PHLEGMONOUS ABSCESS.

A phlegmonous abscess is one which runs its course with unusual rapidity, and which is always accompanied by well-marked inflammatory symptoms. The part feels, as the name implies, as if it were on fire, being hot, tender, and exquisitely painful. A tensive, throbbing sensation is generally present; it is synchronous with the contraction of the left ventricle of the heart, and is always greatly aggravated by dependent position; it is particularly severe at the focus of the morbid action, and is a valuable diagnostic symptom, as it is generally denotive of suppuration. Its immediate cause, as explained elsewhere, is obstructed circulation, and consequent pressure upon the nerves of the affected structures.

If we examine the *anatomy* of a phlegmonous abscess, we shall find it to be a very curious structure, growing out of several highly interesting pathological changes. In the first place, the matter is obliged to have a receptacle for its accommodation. This is usually furnished by the cells of the connecting areolar tissue of the part; but as the accumulation, which is at first drop-like, progresses, this substance is destroyed by ulcerative action, and in this way a cavity is gradually formed, often capable, in the end, of holding an immense quantity of fluid. While the process of deposition is going on, plastic matter is poured out at the periphery of the cavity, gluing up the cellular tissue, and forming thus a kind of boundary line around the pus, by which its diffusion among the surrounding structures is effectually guarded against. No distinct cyst is built up, for nature has not time for such an enterprise, nor is she at all in need of it, although the occurrence is not impossible even in acute abscess, especially in one of the liver. The next circumstance to be observed is the effort which the matter makes to reach the nearest surface, for this is one of the laws of interstitial suppuration. To this object the matter itself is eminently contributary, the pressure which it exerts upon the superimposed parts greatly promoting and expediting the ulcerative action, by whose agency evacuation is finally attained. Thus, at least three separate and distinct processes are going on during the formation of an abscess; a deposit of pus, an effusion of lymph, and ulceration. The importance of an effusion of plastic matter is shown by the fact that, when it fails to be furnished, the contents of the abscess are widely diffused among the surrounding structures, committing extensive havoc in the connective tissues, and causing frightful separation of the muscles. These evil effects are often witnessed in phlegmonous erysipelas, where, in consequence of the caco-plastic character of the lymph, the matter occasionally burrows to a great distance, destroying everything within its reach.

The great law which presides over the evacuation of abscesses, by which their contents are enabled to reach the nearest surface, is attended with the most fortunate results, for it not only abridges suffering, but also saves structure. Thus, in abscess of the liver, a long time would elapse, and an immense amount of pain and constitutional disorder would be caused, if the matter, instead of emptying itself, as it usually does, into an adjoining coil of intestine, were compelled to travel across the walls of the abdomen.

The *contents* of the phlegmonous abscess usually partake strongly of the nature of well-elaborated pus, being of a whitish, or pale straw color, and of a thick, cream-like consistence, with an abundance of large and well-matured pus corpuscles. Intermixed with them are often flakes of lymph, and the debris of the affected structures. Thus, in abscess of the external parts of the body, it is not uncommon to meet with shreds of areolar tissue; in abscess of the liver, with broken-down hepatic substance. Occasionally, again, the pus is blended with the peculiar secretion of the part, as semen in abscess of the testicle, bile in abscess of the liver, milk in abscess of the mamma. A knowledge of these facts is of great practical value, as a means of diagnosis, the nature of the adventitious matter often pointing directly to the seat of the disease. Some forms of acute abscess, as those more particularly which follow severe accidents and capital operations, and to which the term metastatic is sometimes applied, are made up almost entirely of fibrinous matter, the quantity of pus corpuscles being extremely small. The contents of certain abscesses are excessively fetid. This is especially true of abscesses around the anus from the proximity of the pus to the bowel, or from the actual intermixture of fecal matter. The same circumstance occasionally obtains, although generally in a less degree, in abscesses in some other situations, as of the tonsils, bones, and lymphatic ganglions.

Abscesses sometimes contain air, the fluid resting upon the top of the matter. Such an occurrence is most liable to happen in the perineum, about the sacrum, in the ileo-lumbar region, and in front of the abdomen, in consequence of the existence of a communication with the intestinal tube. A similar phenomenon is occasionally witnessed in suppuration of the chest, when the matter contained in that cavity makes an effort to escape externally through one of the intercostal spaces, after an opening has been made into a bronchial tube. In general, the pus, when thus admixed, is excessively fetid, and the abscess is distinctly emphysematous, crepitating under pressure, and often emitting a peculiar gurgling noise.

Phlegmonous abscesses are liable to occur at all periods of life, and in all classes of individuals. We occasionally meet with them within a few weeks after birth, especially in the mamma and in the lymphatic ganglions about the neck, and in the axilla. They may be traumatic, or idiopathic; or, in other words, dependent upon external injury, or constitutional causes, as derangement of the digestive organs, or the suppression of some important secretion, as that of the liver, kidney, or uterus. Abscesses are sometimes of a secondary character, one forming after another, as if there existed a species of pyogenic diathesis. Such an occurrence often proves exceedingly untoward, sadly interfering with recovery, especially when it manifests itself during the progress of convalescence after protracted fevers and severe injuries.

Abscesses of this kind may form in any part of the body; but they are most commonly observed in the areolar tissue, beneath the skin, among the muscles, and around the lymphatic ganglions, as well as in the substance of these bodies, especially in those of the neck, axilla, and groin. Among the internal organs, those that are most liable to suffer are the liver, lungs, and brain, but even here phlegmonous abscesses, except as a result of external injury, are extremely rare.

The number of abscesses varies from one to a great many; being generally in an inverse ratio to their size. Two or three large ones occasionally exist simultaneously in different parts of the body, and, on the other hand, the whole surface is sometimes, as in variola, literally covered with small ones. The size of a phlegmonous abscess ranges from that of a mustard seed up to that of an adult's head.

The *symptoms* which precede and accompany the formation of a phlegmonous abscess are subject to much variety. In general, they are such as characterize ordinary inflammation. The part, when open to inspection, is found to be red, hot, swollen, and painful, beating and throbbing synchronously with the contraction of the left ventricle of the heart. As the matter accumulates, all these symptoms augment in severity, especially if the fluid be bound down by hard, unyielding structures, interfering with its extension. Under opposite circumstances, however, the pain often diminishes, the part feeling relieved almost as soon as the deposition of pus has fairly begun. However this may be, the discoloration of the skin always increases as the matter approaches the surface, and generally assumes a dusky, purple, or livid aspect, particularly at the focus of the abscess. The swelling also augments, and the part often pits on pressure, more or less serum being effused into the subcutaneous cellular substance. The heat is much greater than it is in the surrounding structures, and there is always serious functional disorder.

The morbid action continuing, the centre of the abscess becomes acuminated, and the matter, in surgical language, is said to point. The skin here is not only greatly discolored, but thin and impoverished; and giving way at the most prominent part of the tumor, allows its contents to escape, generally by a small orifice, which is often entirely inadequate to thorough clearance. The period which intervenes between the commencement of the inflammation that leads to the formation of the abscess, and the evacuation of the pus, varies from a few days to several weeks.

When an abscess of this kind is small, or situated in a comparatively unimportant part, the constitution may fail to take any cognizance of it whatever. But this is rather the exception than the rule; for, in the majority of cases, the system warmly sympathizes with the local trouble, and manifests the interest it feels in it by well-marked inflammatory symptoms. If an abscess is about to form in an internal organ, the patient will be seized with rigors, often violent and long continued, alternating with flushes of heat, and generally followed by copious sweats. This frequently happens even when the abscess is of very trivial size; the importance of the affected structures giving proportionate force to the morbid action. Rigors also generally occur in abscesses of the bones and joints, but comparatively seldom when the disease is seated in the subcutaneous cellular substance. Abscess of the ear, parotid gland, tonsils, anus, and perineum are nearly always attended with high constitutional excitement. If the case is at all severe, delirium will be apt to be present, lasting either until the part is relieved, or until the disease proves fatal. The countenance is generally flushed, the eyes are suffused, and there is frequently a hectic spot upon the cheek, especially in internal suppuration. The pulse is full, strong, and frequent; the skin hot and dry; the urine scanty, high colored, and loaded with uric acid. Great thirst and restlessness usually exist. When the abscess is fully formed, the constitutional symptoms, as well, indeed, as the local, often greatly abate, comparative comfort succeeding the violent perturbation. The pulse becomes soft and calm, the surface is bathed with perspiration, the renal secretion increases in quantity and improves in quality, and the patient falls into a tranquil sleep, grateful for the happy change.

Diagnosis.—Notwithstanding that the symptoms of phlegmonous abscess are usually well marked, cases now and then arise where the diagnosis is so obscure as to cause serious doubt respecting their true character. Indeed, there is probably no department of surgery where so many mistakes are constantly committed as in this. If the records of the science could be thoroughly explored, they would, I am sure, be found to abound in blunders of diagnosis in this kind of abscess. As it is, we frequently hear of encephaloid tumors, aneurism, and hernia being opened for abscesses, and life either destroyed upon the instant, or placed in great ultimate jeopardy, by the operation.

Such mistakes are hardly less injurious to the surgeon than to the poor patient; for they but too certainly ruin his prospects and reputation as a practitioner. Attention to the following circumstances will, I trust, enable the reader to steer clear of difficulty: 1. The history of the case; 2. Pointing; 3. Fluctuation; 4. Œdema; 5. The use of the exploring needle.

1. The first object that claims attention is the *history* of the case. Upon inquiry, it will usually be found that the disease has been of short standing; having commenced with the ordinary symptoms of inflammation, and gradually increased until the suppurative point was attained, the fever being high, and the local distress often extreme. Rigors are looked for if the abscess be deep seated, extensive, or among important structures; the pain is tensive and throbbing, steady and persistent, not intermittent, or severe at one time, and absent at another. If the abscess be lodged externally, the swelling is observed to be gravescent, unnaturally hot, excessively tender, intolerant of manipulation, and of a dusky reddish color, especially at its most prominent point. Its career is comparatively brief, a few days, a week, or, at most, a fortnight, sufficing to reach its acme. Then comes the period of dissidence, if the matter is not evacuated; the symptoms abating in severity, the pulse and skin becoming soft, and the pain losing its throbbing character.

2. *Pointing* is a symptom of great importance in the diagnosis of phlegmonous abscess. It is always most conspicuous where there are, or were, most pain and discoloration. The skin looks dusky or livid, and feels thin and attenuated as if it were ready to give way, which, in fact, it generally is. A tumor, benign or malignant, may also point, but a careful consideration of the history of the case will commonly suffice to show the difference.

3. An abscess, near the surface, always *fluctuates*, that is, its contents permit themselves to be displaced on one side, and to be rendered correspondingly prominent upon the opposite. Two methods may be adopted in conducting the examination. In one, alternate pressure is made with the hands or fingers resting upon opposite sides of the abscess. As one hand or finger sinks in the other is elevated, and whenever this is the case there can be no question about the existence of fluid, although the fluid may not be purulent. The other method consists in percussing the tumor with one hand, the other hand being placed upon the opposite side. If matter be present, an undulatory motion will be imparted, one of the surest signs of the occurrence of suppuration. This method, however, is less delicate than the other, and is applicable only to abscesses of unusual volume. Finally, when the matter is seated superficially, its presence may often be detected by passing the finger over the most prominent part of the swelling, when; if there be pus, it will generally sink in a little, in consequence of the skin at that part being less resistant than at the periphery of the tumor. This method of examination is particularly valuable in small superficial abscesses of the scalp, perineum, tibia, clavicle, fingers, and other superficial portions of the skeleton.

4. Valuable information is often obtained from the appearance of the *swelling*. Thus, when the matter is very deep seated, as in abscess of the thigh, the existence of œdema is nearly always decisive of the nature of the case, especially when it is conjoined with a hard, brawny state of the parts. The fluid cannot reach the surface on account of the manner in which it is bound down, but its presence causes inflammation in the skin and subjacent cellular substance, leading to an effusion of serum, and consequently to more or less pitting under the pressure of the finger. In empyema, or purulent collections in the pleura, œdema of the chest, directly over the seat of the fluid, is usually a prominent, and, indeed, in many instances, a characteristic symptom. A puffy and œdematous state of the scalp is often denotive of abscess of the brain and dura mater, in cases of injury of the skull.

5. The *affections* which are most liable to be mistaken for abscess are ence-

phaloid, aneurism, and hernia. From the first of these the history alone of the case will generally suffice for a correct diagnosis. Encephaloid is a chronic affection; a phlegmonous abscess, an acute one; the first is attended with little or no pain until ulceration sets in; the latter is attended with a great deal, generally from the moment it begins until it is evacuated. An abscess may be mistaken for an aneurism, especially if it be seated over a tolerably large artery, which communicates to it its impulse. I recollect a notable case of this kind which occurred, many years ago, in the Louisville Hospital, and which created quite a sensation at the time. The patient, a young English sailor, had a globular tumor, the volume of a fœtal head, in the epigastric region. It had existed there, in a marked degree, for upwards of a month, and as it received a distinct impulse from the aorta, it was believed by the surgeons in attendance to be an aneurism of that vessel. The patient was apprised of the supposed nature of his disease, and his only regret was that he should never be able to reach his native country. The man soon after this fell into the hands of Dr. Donne and myself, when, upon introducing an exploring needle, we found that the tumor was not an aneurism, but an abscess seated deeply in the wall of the abdomen.

A strangulated hernia of the groin, abdomen, or upper part of the thigh might be mistaken for an abscess, but such an accident could hardly happen in the hands of an experienced surgeon. The history of the case, the peculiar character of the swelling, and the existence of symptoms of strangulation will always be sufficient to clear up any doubt that may arise respecting the nature of the case.

6. When, notwithstanding the most thorough scrutiny of the case, its nature remains undetermined, recourse must be had to the exploring needle, which often decides the question in a moment. The instrument which I usually prefer is an ordinary cataract needle, introduced at the most prominent part of the swelling down to its very centre, and freely rotated upon its axis, in order to condense the walls of the puncture, and thereby facilitate the flow of fluid. If the contents be purulent, the circumstance will be revealed by the appearance of a drop of pus at the orifice; whereas if the swelling be an aneurism the discharge will be sanguineous. If the tumor be encephaloid, probably nothing will appear, except a little blood consequent upon the penetration of the instrument.

Prognosis.—The prognosis of this disease is influenced by a variety of circumstances, of which the most important are the size, number, and seat of the abscesses, and the age, habits, and constitution of the patient.

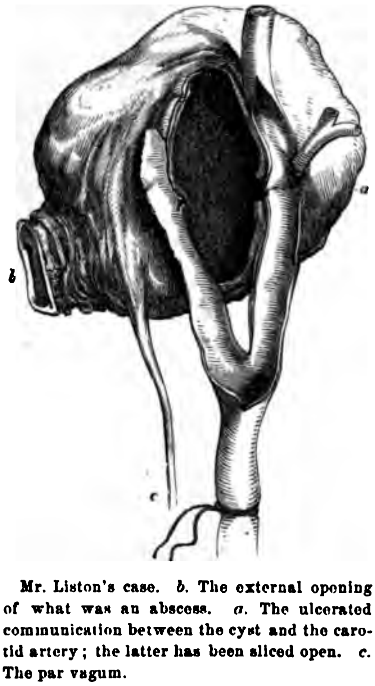
A large accumulation of pus is, other things being equal, more dangerous than a small one, because it not only produces more havoc among the tissues, but it exerts more severe pressure upon the surrounding parts, and establishes a greater drain upon the system. Number has an important bearing upon the prognosis. A man may struggle through several abscesses, even when of considerable bulk, but when he is laboring under a great many he must be extremely fortunate, indeed, if he do not sink under them. Smallpox is always a dangerous disease, chiefly on account of the enormous number of abscesses which attend its progress; few patients being capable of withstanding the irritation and consequent prostration occasioned by their development. The situation of the matter is an object of importance. Thus a small abscess of the perineum may cause fatal retention of urine, as a small abscess of the fauces may induce death by compression of the glottis. Importance of structure is another circumstance which influences the issue of the case. An abscess of an internal organ, as the liver, is more dangerous, and more likely to prove fatal, than an abscess of an external part of the body, as a lymphatic ganglion.

This book is the pr
COOPER MEDICAL C
SAN FRANCISCO, CAL.

The recovery of a person laboring under phlegmonous abscess is often materially influenced by his age, habits, and state of constitution. Young adults and middle-aged subjects usually get on better than children and very old persons, who often meet such attacks very poorly, making a very feeble show at resistance. The intemperate man has a worse chance than one of good habits, and the man of bad previous health than one who has always had an excellent constitution.

Treatment.—The treatment of phlegmonous abscess is conducted upon general antiphlogistic principles; by depletion, purgatives, antimonials, and the ordinary topical means, to limit deposit and save structure, and afterwards by the lancet to favor evacuation and reparation. Sometimes spontaneous removal is looked for, as when the abscess is seated just beneath the periosteum, as an effect of tertiary syphilis, or when it occupies a lymphatic ganglion, and has yet made little progress; favored, if necessary, by the administration of mercury and iodide of potassium, and the application of iodine, blisters, and other sorbefacients. But such cases are exceptional, and do not affect the general rule of practice, which always seeks an early outlet for the pent-up fluid. In some situations we do not even wait for well-marked pointing, much less distinct fluctuation; but, assured that matter is present, make an early and free incision, thus abridging suffering and saving structure. The beneficial effects of this practice are strikingly illustrated in abscesses in various parts of the body. Thus, in purulent collections around the anus, an early outlet is indispensable to prevent the matter from burrowing along the side of the rectum and perforating its walls, thereby forming an anal fistule. Abscess of the perineum requires prompt interference to prevent retention of urine and the establishment of urethral fistule; of the fingers, to prevent the matter from travelling along the sheaths of the tendons and so producing extensive sloughing and necrosis; of the fauces and tonsils, to prevent suffocation by the pressure of the swelling upon the glottis. The torturing pain of a gum-boil, an abscess of a tooth, bone, and periosteum, is often instantly relieved by an early and free incision. The same procedure in deep-seated abscess of the extremities not only relieves pain and constitutional irritation, but prevents the pus from burrowing among the muscles, and thus causing extensive destruction of the connecting cellular tissue.

Fig. 15.



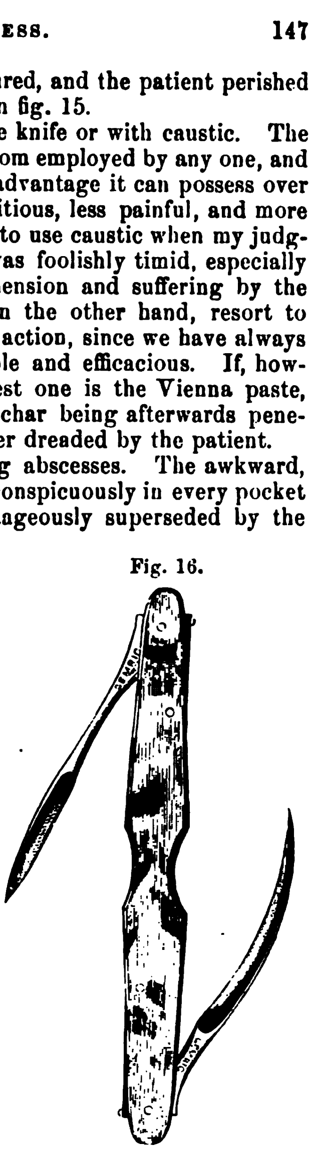
Mr. Liston's case. *b.* The external opening of what was an abscess. *a.* The ulcerated communication between the cyst and the carotid artery; the latter has been sliced open. *c.* The par vagum.

An abscess should be opened early when, from its proximity to a large vessel, there is danger that, if neglected, a communication will be established between them, thus leading to fatal hemorrhage. Such an event will be particularly liable to occur in delicate children laboring under the effects of scarlatina, measles or smallpox, and in elderly subjects worn out by long suffering and an impoverished state of the blood. The arteries most subject to this danger are those about the neck. In Mr. Liston's celebrated case, the abscess opened into the external carotid; it was punctured, and the patient perished from hemorrhage. The parts are represented in fig. 15.

Artificial evacuation may be effected with the knife or with caustic. The latter, at one time so much in vogue, is now seldom employed by any one, and it would be difficult to conceive what possible advantage it can possess over the former, which is incomparably more expeditious, less painful, and more certain. I would not so far humor a patient as to use caustic when my judgment plainly condemned it, simply because he was foolishly timid, especially now that we can so readily prevent all apprehension and suffering by the administration of anæsthetics; nor would I, on the other hand, resort to caustic with the view of promoting suppurative action, since we have always at our command articles infinitely more desirable and efficacious. If, however, such a remedy should be called for, the best one is the Vienna paste, applied as in making an ordinary issue, the eschar being afterwards penetrated, if need be, by the bistoury, now no longer dreaded by the patient.

Various instruments are employed for opening abscesses. The awkward, clumsy thumb lancet, which formerly figured so conspicuously in every pocket case, is now seldom used, having been advantageously superseded by the scalpel and bistoury. The scalpel is, however, rarely employed, except in very large abscesses, where it is necessary to make a very free division of the overlying structures. By far the neatest contrivance for the purpose is the little bistoury, represented in fig. 16, which I have used, almost exclusively, for many years. It consists of two very narrow, sharp-pointed blades, one straight, and the other slightly curved, short, yet long enough to reach to the desired depth in almost any case likely to fall under the observation of the practitioner. Selecting the most prominent, and, if possible, also the most dependent, portion of the abscess, the instrument is plunged perpendicularly through the skin, into the very midst of the matter, its arrival there being indicated by a want of resistance and probably also by an escape of a few drops of fluid, especially if this be rather thin. The puncture thus made is then converted into an incision, by depressing the handle of the bistoury, and cutting from within outwards, the length of the opening varying, on an average, from a third of an inch to an inch, according to the volume of the abscess. In general, it is better that the opening should be too large than too small, as the object always is to afford free vent to the pent-up fluid. Care, of course, is taken, in introducing the bistoury, not to interfere with any important vessels and nerves, or to perforate any important cavity.

Fig. 16.



Bistoury.

When the abscess is very deep seated, as, for instance, when it occupies the muscles of the thigh, the walls of the abdomen, the groin or axilla, the safest plan will be to divide the skin and fascia freely with the knife, and then to push, very cautiously, as has been suggested by Mr. Hilton, a grooved director or pair of forceps into its interior.

Penetration having been effected, the matter usually escapes of its own accord, simply by the pressure of the atmosphere; but the evacuation may be aided, if necessary, by the hand or finger, used, however, with the greatest gentleness, otherwise it may not only cause severe pain but an aggravation of the inflammatory action. Too much caution, indeed, cannot be observed in this particular. Nothing can be more reprehensible than the rude manipulations which we so often see practised after this operation, even by surgeons otherwise well educated. To prevent the incision from healing by the first intention, and the necessity of the repeated use of the knife, a small tent, well oiled, made of old linen, is interposed between its edges, one extremity being carried a short distance into the now empty sac, and the other left slightly pendent externally, substitution being effected once in the twenty-four hours. The best application for the surface of the abscess is an emollient cataplasm or the warm water-dressing; but this should not be made until bleeding has ceased, otherwise a troublesome hemorrhage might ensue. As soon as the parts have become perfectly comfortable, the warm dressing is discontinued, on account of its relaxing tendency, a piece of lint, spread with simple cerate, or wet with olive oil, being used in its stead.

When the abscess is seated in a bone, evacuation must be sought with the trephine; but the operation is not always certain of success, owing to the difficulty of the diagnosis.

When the abscess is of large size, or when it has been productive of extreme separation of the muscles, its sides should be approximated, after evacuation, by means of a thick and well-adjusted compress, secured by adhesive strips, or, in the event of the abscess being seated in an extremity, by the common roller, extending upwards from the distal part of the limb; care being taken not to interfere with the artificial opening. In this way a cavity that would not otherwise close under several weeks, will often be effectually obliterated in a few days.

An abscess is sometimes prevented from healing by the unfavorable position of its opening, whether natural or artificial, the matter accumulating in a kind of sac, situated between the orifice and the bottom of the swelling. Such a state of things calls for what is termed a *counter-opening*, which is easily established by making an incision at the most dependent part of the sac, upon the end of a grooved director, introduced through the previous and now useless aperture. Counter-puncture is often necessary in abscess of the neck and parotid region, from the gravitating tendency of the matter in these situations. Sometimes, again, an opening of this kind is called for on account of the change in the position of the part after the first operation, performed perhaps well enough at the time. Whatever may be the circumstances demanding it, patency is maintained with more care, if possible, than under ordinary circumstances.

Again, reparation may be rendered tedious, if not impracticable, by the existence of a *sinus*, extending, perhaps, deeply among the surrounding parts, or, it may be, communicating with some natural cavity. When this is the case, the most speedy and effectual remedy is incision with a bistoury upon a grooved director, inserted into the bottom of the track, the parts being thus laid into one, and permitted to heal by granulation, readhesion being prevented by the constant interposition of a piece of lint. In the milder cases, steady and systematic compression sometimes succeeds in obliterating the abnormal channel; sometimes, again, gently stimulating injections are useful; and, finally, there is a class of cases where the seton is worthy of trial. In general, however, these means only serve to amuse the patient, and annoy the surgeon, who is at last compelled to have recourse to the remedy which his judgment tells him he should have employed in the first instance.

Hemorrhage is not common after this operation, but it may take place in spite of the utmost precaution on the part of the surgeon, and may prove quite troublesome from the difficulty of finding its source. The proper remedy is the ligature, the vessel being seized and drawn out with the tenaculum, or surrounded with a curved needle. Gentle compression sometimes answers the purpose, especially if the bleeding be venous, or if it proceed from a number of small points. If a considerable sized artery has been laid open, and cannot be easily reached, the incision should be dilated to effect the necessary exposure.

The *healing* of an abscess, whatever may be the manner of its evacuation, is effected by the contraction and approximation of its walls, which generally begin the moment the matter has escaped, and steadily progress until the sac is completely obliterated. The raw state of the opposed surfaces strongly predisposes them to unite with each other; an occurrence which is always favored by an effusion of plastic substance. If the cavity of the abscess were obliterated, as was formerly supposed, by granulations, the part would remain hard and prominent for a long time; but this is not the fact. On the contrary, it soon shrinks, becomes soft, and drops down to a level with the surrounding surface. The opening alone unites in this way; but even this is not always so, for cases constantly occur where it closes by the first intention.

Although, as a general rule, the outer wall of the abscess soon recovers its pristine softness and pliancy, yet occasionally the reverse is true, the parts remaining hard, tender, and enlarged, being seemingly reluctant to throw off their inflammatory burden. To expedite resolution, the affected surface may be covered with a gum ammoniac and mercurial plaster, probably the very best remedy that can be used for the purpose; or rubbed several times a day with some sorbefacient liniment, unguent, or embrocation, aided, perhaps, by the bandage and a few alterative doses of mercury.

2. DIFFUSE ABSCESS, OR PURULENT INFILTRATION.

The above is one variety of phlegmonous abscess; the circumscribed, in which, united with rapidity and severity of action, the matter is bounded by a distinct wall of fibrin, serving the purpose of a cyst, although in reality there is no such formation. In the present variety, already incidentally adverted to, there is no connective exudation, and the consequence is that the pus is widely diffused among the surrounding structures, dissecting and separating them from each other in the most frightful manner. Such collections, which are generally attended with intense suffering, are often described under the appropriate and expressive appellation of purulent infiltration.

The diffuse form of abscess is met with under a great variety of circumstances, both as it respects the nature of the exciting *cause* and the condition of the general system. It is most common in persons whose constitution has been dilapidated by intemperance in eating and drinking, by want and exposure, and by organic affections of the heart, lungs, liver, bowels, and kidneys, leading to anemia, obstructed circulation, and exhaustion of the vital powers. When such persons meet with a serious accident, or suffer from a prolonged attack of fever, suppuration is extremely prone to take on this kind of action, often sadly complicating the original disease. Diffuse abscesses are also sufficiently common after severe injuries, as compound fractures and dislocations, lacerated, railway, gunshot, and dissection wounds, and capital operations, especially amputations of the larger limbs and resections of the bones and joints. Persons of a scrofulous constitution are, on the whole, more liable to suffer from diffuse suppuration than any other class of individuals, their vital powers being too feeble to enable them to furnish a sufficiency of fibrin to limit the purulent matter that is so often effused under the above circumstances.

Diffuse abscesses may occur independently of any other appreciable disease, or they may take place in conjunction with erysipelas, pyemia, or phlebitis, which they resemble very much both in their mode of origin and in the character of their symptoms. Their presence, in fact, is always denotive of a bad or depraved state of the system; in some cases the fault apparently lies in the blood, either in a defect of some of its more important constituents, or in the ingress of some morbid poison; in others, again, it seems to depend upon imperfect action of the skin and kidneys, excess of food and drink, the respiration of impure air, over-action of the brain, or exhaustion of the nervous system.

The *symptoms* of this variety of abscess are ordinarily bold and well defined. In general, the disease is ushered in by considerable shivering, if not by a severe rigor, followed by heat and perspiration; the pulse soon becomes small, quick, frequent, and irritable, the extremities are cold, the urine is scanty and high-colored, the appetite is destroyed, the tongue is covered with a brownish fur, the strength rapidly fails, and the patient soon sinks into a state of delirium. Great irritability of the system exists; the pain is often excessive, sleep is interrupted, and the mind is peevish and fretful. Frequently the symptoms are of a typhoid character from the beginning; if not, they are sure soon to become so; and yet not merely typhoid, but typhoid and irritative, the two classes being generally well balanced throughout.

The local symptoms are those of ordinary inflammation, only that they are more severe, especially when the matter is deep seated. The discoloration is of an erysipelatous nature, the parts are swollen and pit on pressure, the pain is smarting and pulsatile, and the skin feels hot, stiff, and numb. If the matter lies immediately beneath the surface, or among the more superficial muscles, a boggy sensation will be imparted to the hand of the examiner, and a little pressure will be sufficient to push the fluid about from one place to another, sometimes to a distance of many inches. When, on the contrary, the pus lies far below the surface, being bound down by muscles and aponeuroses, its early detection will generally be very difficult; under such circumstances, the best guide to its situation will be the history of the case, the deep-seated pain, the presence of œdema of the skin and areolar tissue, and the character of the constitutional phenomena. If any wounds or sores exist, they speedily dry up, and assume an unhealthy appearance.

Any part of the body may become the *seat* of diffuse abscesses, but their most common situations are the limbs, in which the matter often burrows to a great extent, both beneath the integuments and among the muscles; in some of the worst forms that I have ever seen, it lay in immediate contact with the bones, separating them from the soft structures, and even from the periosteum. In a case, which was under my observation some years ago, the purulent fluid had spread along the posterior surface of the lower extremity, in close contact with the femur and the bones of the leg, from the hip as far down nearly as the heel.

The *matter* which accompanies this variety of abscess is always of an unhealthy character; it is generally thin, sanious, irritating, acrid, and excessively offensive, often tainting the atmosphere of the apartment for many feet around, and fastening itself upon the hands and clothes so as to be perceptible for hours afterwards, notwithstanding perhaps the liberal use of the chlorides. In fact, the stench is usually of the most disgusting character. In some cases the fluid approaches more nearly to the properties of ordinary pus, but this is uncommon. Occasionally extensive sloughs form, especially in the cellular tissue; so that the disease may be said to partake of the character both of suppuration and of gangrene.

The *prognosis* of this form of abscess is generally most unfavorable, there being few constitutions that can withstand its depressing effects. The very fact that such a disease is in operation shows, as already stated, that the system is in a depraved condition; and when it is recollected that some of this foul matter must necessarily find its way into the circulation, contaminating everything with which it comes in contact, it is not difficult to anticipate what the result will be likely to be, even when the purulent collection is not very extensive, especially in persons already exhausted by shock, loss of blood, or lesion of some important organ.

The *treatment* of diffuse abscess is sufficiently obvious. The leading indications are to evacuate the matter, and to support the system. The first is fulfilled by early and free incisions, practised at the most favorable site for ready drainage, with the precaution of avoiding hemorrhage, the smallest quantity of which is sometimes sufficient, under such circumstances, when life is, as it were, quivering in the balance, to bring on fatal exhaustion. Counter-openings are often necessary. After the fluid has been thoroughly evacuated, recourse is had to the bandage, for the purpose of effecting approximation of the sides of the abscess; a means of support which is frequently of the greatest consequence, not only in preventing the extension of the matter, but in promoting the healing of the parts. When the fluid is excessively offensive, the cavity of the abscess should be well syringed several times a day with tepid water, charged with a suitable quantity of liquid chlorinate of soda, which, while it will allay fetor, will be instrumental in imparting a healthy action to the disabled structures. If sloughs form, they should be speedily removed, the knife being used, if necessary, to effect their separation. The parts are placed in a proper position for facilitating drainage: and are enveloped in warm water-dressings, or emollient poultices, medicated with acetate of lead and opium.

Among the more important internal remedies are anodynes, quinine, ammonia, iron, and brandy, with animal broths and soups, and a pure atmosphere, which is of paramount importance to the recovery of the sufferer. For this purpose, the windows and doors of the apartment should be frequently thrown open, the dressings changed, and disinfecting agents used. Anodynes are indispensable to allay pain and induce sleep, and should be administered in full doses, either in the form of morphia, opium, or black drop. The best tonics are quinine and brandy, given in the same manner as in typhoid fever; the tincture of the chloride of iron, in doses of from fifteen to twenty drops, every three or four hours, will also be of service; and, in many cases, ammonia, in camphor mixture, will meet the exigencies of the case better than almost any other remedy, especially when there is hiccough with twitching of the tendons.

3. SCROFULOUS ABSCESS.

The scrofulous abscess is of such frequent occurrence, and possesses, withal, such distinctive features, as to entitle it to separate consideration. It is known by various names, some of which have reference to its progress, some to its symptoms, some to the nature of its contents, or to the state of the constitution which precedes and accompanies its formation. Thus, it is often described as the chronic abscess, tardy development being one of its characteristic features; the word cold is frequently employed on account of the absence of inflammatory symptoms; but scrofulous is the appellation by which it is generally known at the present day. As implying the same thing, the terms strumous and tubercular are much in vogue. There is a form of this abscess to which the name *congestive* has been applied, from its tendency to change its position, although it is impossible to discover any etymological fitness in the expression.

The scrofulous abscess is altogether a singular production; singular in its origin and progress, and singular in respect to its treatment. It is never met with, except in the strumous constitution. The phlegmonous abscess is common to all persons, of every age, grade, and condition in life; the scrofulous, on the contrary, can occur only in persons who have a predisposition to scrofulous affections, whom nature has stamped, so to speak, with a peculiar diathesis, or state of the system, rendering them prone to phthisis, coxalgia, caries of the spine, and other kindred maladies. Its sphere of action is, therefore, comparatively limited, a hundred cases of phlegmonous abscess occurring to one of a scrofulous character.

The progress of scrofulous abscess is peculiar. It is always slow, weeks and months often elapsing before it acquires any considerable bulk. Hence the term chronic, by which it is so frequently designated. Phlegmonous abscess, on the contrary, is always rapid in its progress, generally attaining its full development in a very short time. Another peculiar feature of the strumous abscess is the absence of the ordinary inflammatory symptoms. There is neither heat nor redness of the skin; instead of this, the surface is cold and blanched, the part feeling and looking as if there were great deficiency in its circulation. Hence this variety of abscess is often termed cold, especially by the German surgeons, who were the first to describe it. Pain, too, is absent, or, if it exist, it is so slight as hardly to attract attention. Functional disorder also is very slight, especially in the earlier stages of the disease. Looking at the constitution, we find the same uncommon train of phenomena. The general health may be somewhat impaired; the strength may slowly and almost imperceptibly decline; and the countenance may have a pale, sallow appearance; but there are none of the open and well-marked inflammatory symptoms which attend the march of a phlegmonous abscess, and which, especially when the disease is located in an important internal organ, suggest the idea of great and immediate danger. Thus, as far as appearances are concerned, the affection is one seemingly of little moment; its discovery is often purely accidental, and, for a while, both patient and surgeon may be wholly unconscious of its true character. It is, indeed, as completely different from the ordinary abscess as it is possible for one disease to be from another. Scarlatina and measles are not more unlike each other.

The strumous abscess is very frequent in the lymphatic ganglions, subcutaneous cellular tissue, and dorso-lumbar region. The testicle and liver are also sometimes its seat. In the lungs, however, it is more common than anywhere else, being the immediate product of the softening of tubercular matter, eventuating generally in the formation of what are termed vomicæ, or pulmonary caverns. In the external parts of the body it is usually situated in the neck, on the chest, in the axilla, on the loins, in the groin, or upon the superior portion of the thigh. Large strumous accumulations sometimes form in connection with the movable joints.

Some diversity obtains in regard to the size and number of this abscess. In certain situations, as in the lungs, they are always small, but at the same time often quite numerous; while in others, as in the cervical glands, on the chest, in the groin, and on the back, they are usually single, and from the volume of an orange to that of a fœtal head.

The strumous abscess is nearly always furnished with a distinct cyst, bag, or capsule, technically called the *pyogenic* membrane, which, while it serves to individualize it, separates it effectually from the surrounding parts. At what period of the suppurative process the membrane begins to be formed is not determined, but that it is developed at an early stage is unquestionable. It has been supposed, singularly enough, that its formation, at times, precedes the deposition of the pus; but for such an opinion there is not, so far as I can perceive, any well-founded reason. The subject, however, does not admit of easy demonstration; for it is seldom that we have an opportunity of inspecting an abscess of this description until after it has attained considerable bulk, and the membrane has acquired some degree of development. The most plausible conjecture that can be framed respecting it is, that the membrane is formed out of the necessity of the case, nature intending it as a means of limiting the diffusion of the pus, which would otherwise inevitably happen in consequence of its tardy but steady deposition. To accomplish this object she sets up around the purulent depot, at an early period of the morbid action, a species of adhesive inflammation, by which, in the first place, the cells of the neighboring tissues are effectually occluded, the process being precisely similar to that which occurs in an ordinary phlegmonous abscess. Thus, the secretion is temporarily circumscribed, but, as may readily be perceived, the barrier thus opposed would soon yield before the accumulating burden, and thus thwart nature's intentions. To prevent this a wall of plastic matter is next constructed, which no amount of pus, however great, can, for a time, break down or destroy. The thickness of this wall varies from the eighth of a line to the eighth of an inch; its density steadily increases with its age, and hence it is often found to be of a fibrous consistence, with here and there a semi-cartilaginous patch. Its outer surface is rough and intimately united with the surrounding structures; the inner, on the contrary, is either perfectly smooth, or studded with minute granulations, not unlike the villi of the small intestines, only not so regular and numerous. Its vascularity, which is always considerable, is easily distinguishable by the naked eye, as well as by minute injection. It also, no doubt, contains nerves and absorbents, although none have yet been demonstrated.

No one can reflect upon the structure of this membrane without being impressed with the conviction that it is invested with important functions. In the first place, as has already been stated, it protects the tissues in the immediate neighborhood of the abscess from the diffusion of its contents; a circumstance which could not fail to be productive of great injury, inasmuch as the matter, burrowing about in different directions, might occasion extensive separation of the muscles, which it would afterwards be extremely difficult to remedy. Secondly, the membrane is an important secreting structure, since it furnishes the matter which it incloses, not directly, but through the agency of lymph, which is speedily transformed into pus. Thirdly, it is also an absorbing structure, as is proved by the fact that the matter which it contains occasionally entirely disappears, either spontaneously, or under the influence of treatment. Finally, the membrane possesses important sympathies with the rest of the system. Let alone, it silently enjoys its parasitic existence, preying upon the parts around without any serious general detriment, but the moment it is opened or disturbed by rough manipulation, it resents the aggression, and is sure to give rise to severe constitutional derangement.

The pus of the strumous abscess is generally of a whitish or yellowish cast, slightly inclining to greenish, of a tolerably thick consistence, free from odor, and intermixed with caseous particles, looking and feeling very much like pieces of soft-boiled rice. Instances occur, especially in scrofulous disease of the lymphatic ganglions of the neck, where it is very thin, pale, and full of curdy substance, consisting apparently of imperfectly broken-down tubercular matter. When long retained, or situated near the ano-rectal region, scrofulous pus is sometimes excessively fetid, either from actual decomposition, or the presence of sulphuretted hydrogen. If it be permitted to stand for some time, it separates into two parts, one of which is thin, whey-like, or sero-oleaginous in its appearance, the other thick and curdy, the former being always upon the top of the latter. Like the pus of the phlegmonous abscess, it occasionally, although rarely, contains the debris of the organs in which it is formed, and also some of their peculiar secretion. Thus, a strumous abscess of the liver occasionally contains bile; of the breast, milk; of the spine, osseous particles.

In regard to quantity, there is much variety in the pus of this form of abscess. In psoas abscess, which is one of the best examples of the disease, the accumulation is sometimes enormous, reaching several quarts, or, perhaps, even a gallon. In scrofulous abscess in the glands of the neck, there is also occasionally a good deal of pus, although, in general, it is small. Large collections of strumous matter are sometimes seen in chronic abscess beneath the skin, especially in the lower extremity. A young woman, a patient at the College Clinic, had an abscess of this kind on the left thigh, containing nearly a gallon of pus.

The diagnosis of this form of abscess may be gathered from the remarks which have been made respecting that of phlegmonous abscess. The only two affections with which it is at all likely to be confounded are encephaloid and aneurism; but from these it may usually be easily distinguished by the history of the case, the fluctuating character of the swelling, and, if necessary, the use of the exploring needle.

Treatment.—The treatment of this abscess differs essentially from that of the phlegmonous. In the latter, the system often bears energetic measures; in the former, seldom, if ever; in the one, the surgeon does not hesitate to make an early and free incision into the swelling, with a view to the early evacuation of its contents; in the other, he waits and hesitates, well knowing that such an operation is often the prelude to serious constitutional disturbance, if not death. The one is the work of a few days, or, at most, of a few weeks, taking the part and system, as it were, by surprise, and, therefore, requiring prompt interference; the other is the work of time, affording the part and system an opportunity of accommodating themselves to its presence, and, therefore, often intolerant of interference. When the quantity of matter is small, removal is occasionally effected by absorption, the process being sometimes advantageously aided by internal and external remedies, particularly the iodide of potassium and the bichloride of mercury, together with sorbefacient plasters, unguents, and embrocations. These means are more particularly available in chronic abscesses of the glands of the neck, groin, and axilla, and in those of the mamma and subcutaneous cellular tissue. In psoas and lumbar abscesses, on the contrary, little or no benefit usually results from their employment, beyond the influence they may exert in improving the general health, and removing the strumous diathesis. When general debility exists, relief should be attempted with tonics, as quinine and iron, along with milk punch, and change of air.

Concerning the evacuation of strumous abscess, no one hesitates to interfere, when the disease is seated in the external parts of the body, as the mammary gland, the lymphatic ganglions of the neck, or the subcutaneous cellular tissue. In such cases, indeed, we can hardly make too early or too free an incision; for, not only is there, as a general rule, no danger of causing constitutional disturbance, but the procedure is eminently calculated to save structure and promote recovery. The matter being evacuated, the cavity usually at once contracts, and the tendency to secretion gradually diminishing, the part finally heals by granulation or adhesion. Besides, such a procedure always enables the surgeon to watch the morbid action, and apply his remedies directly to the affected surface.

The best local applications, after the abscess has been punctured, are emollient poultices, rendered slightly stimulating by the addition of a little common salt; or tincture of iodine, spirituous lotions, or some sorbefacient plaster, as the gum ammoniac and mercurial, soap, compound galbanum, or iodine plaster, care being taken to leave an appropriate opening for the discharge of matter. I can speak with great confidence of the beneficial effects of these plasters, especially the first, having used them for a long time in the treatment of strumous abscess of the neck, mamma, and subcutaneous cellular tissue. When the cavity of the abscess is slow in healing, in consequence of the torpor of its vessels, or the existence of a strong pyogenic membrane, nitrate of silver, nitric acid, or acid nitrate of mercury may be employed, in the form of weak injection, as local stimulants until there is a disposition to the formation of healthy granulations. Sometimes, as in the case of the subcutaneous abscess, a seton may be advantageously introduced, retention being maintained until the sac has become obliterated by inflammation. Or, instead of this, a counter-opening may be made, and a tent inserted.

When the abscess is connected with disease of the bones, as it always is when it takes the name of psoas or lumbar abscess, the treatment usually followed is that originally suggested by Mr. Abernethy, and which consists in making a valve-like opening in the most prominent and dependent portion of the swelling. The object of this procedure is to exclude the atmosphere, not that this is of itself at all injurious, as was at one time erroneously supposed, but because its contact with the purulent matter has a tendency to cause decomposition; an occurrence which cannot fail to be succeeded by bad consequences, by awakening all the constitutional sympathies of which such a disease is capable. Educated in a school in which this practice was strongly inculcated, and warmly prepossessed in its favor, on account of the high authority of its originator, I was led to expect from it all that the most sanguine feeling could anticipate; but, after an experience of upwards of twenty-five years, I am compelled to say that it has utterly disappointed me, in the only class of cases to which, in my judgment, it is at all applicable. I cannot, in truth, recall to my mind a solitary instance in which I have found it productive of the least permanent benefit. My experience is that the opening, however judiciously made, will, at no distant day, be followed by ulcerative action, leading thus to all the bad effects that are usually caused by making a free incision in the first instance. I believe that this generally occurs, whatever may be the amount of matter evacuated, whether small or large, and whether the operation be repeated at long or short intervals. It has appeared to me that any interference, however trivial, is always sure to be resented, and that, instead of benefiting the case, we only render it worse. Hence, I am satisfied that, when the pain from the pressure of the accumulated fluid is not so great as imperatively to demand its withdrawal, it is best, as a general rule, to let the part alone, patiently waiting for spontaneous evacuation, and the accommodation of the part and system to the approaching event.

When artificial evacuation becomes necessary, it may be effected simply with the knife, the trocar, or the knife and trocar together. Whatever instrument is employed, care is taken to carry the point some distance between the skin and sac, before the latter is penetrated, so as to give it the valvular form so much insisted upon by the advocates of this mode of treatment. From two-thirds to four-fifths of the matter having been withdrawn, the orifice is accurately closed with two broad strips of adhesive plaster, arranged crucially, and supported by a compress and bandage. Care is also taken to prevent the orifice from being pressed upon by the reaccumulating fluid, lest it should reopen spontaneously. The operation is repeated from time to time as the matter collects, an opportunity being thus afforded to the abscess to contract, and finally to become obliterated; an event, however, that is certainly extremely rare.

It was proposed, some years ago, to open these abscesses while the patient's body is immersed in water, on the ground that there would thus be less likelihood of the introduction of air; but we may well ask whether the ingress of the former fluid would not be quite as injurious as that of the latter? The truth is, it is hardly possible to perform the operation without some risk of this kind; still, if proper care be taken, the quantity will be so small as not to produce any serious mischief.

As to iodine injections, which have been recommended for the radical cure of this form of abscess, the experience of the profession has nothing to offer in their favor. The practice, considered in a purely theoretical point of view, is sufficiently plausible, since its object is to change the character of the secerning surface of the pyogenic membrane, by inviting an effusion of plastic matter, which shall lead to the obliteration of its cavity. It was evidently suggested by the beneficial effects which are known to follow the use of iodine injections in hydrocele and other kindred affections, but to insist upon a similarity of structure of the sac of a chronic abscess to that of the vaginal tunic of the testicle certainly displays a very limited and imperfect knowledge of morbid anatomy. It is not surprising, therefore, that the practice should have failed, and that its employment should have been attended, in most cases, with considerable risk, from the tendency which it has to create undue irritation both in the part and system.

Whatever mode of treatment be employed, it is of paramount importance to sustain the system by tonics and to allay pain by anodynes.

4. MULTIPLE ABSCESS, OR PYEMIA.

The fact that some injuries and operations are occasionally followed by the development of abscesses in some of the internal organs of the body did not escape the attention of some of the older surgeons. Ambrose Paré makes distinct mention of the occurrence; and Pigrai, about the same period, had an opportunity of noticing that, during one particular year, nearly every person who was so unfortunate as to have a wound of the head died of suppuration of the liver. These observations were afterwards confirmed by Morgagni, Bertrandi, and Andouillé; and, more recently, by Schmucker, Kern, Klein, Hennen, Larrey, Guthrie, and other military surgeons, as well as by many hospital and private practitioners. Mons. Velpeau, however, was the first to investigate the lesion in a really scientific manner, and to institute a thorough and elaborate examination into its etiology, pathology, and treatment.

The name pyemia, by which this affection is now generally known, literally signifies an alteration of the blood by pus, or, perhaps, more properly speaking, an admixture of the two fluids, giving rise to what has been called septicemia, or purulent infection. It is a corruption of pyohemia, first applied to this disease by Piorry, and is synonymous with ichorhemia, a term recently introduced into pathology.

The exciting causes of pyemia, or blood-poisoning, are not only numerous but of a highly diversified character; they may be stated, in general terms, to be such as are productive of great shock to the system, loss of blood, or depression of the vital powers. As following severe injuries of the head, it was, as already stated, long ago noticed by many of the older pathologists and surgeons, although they failed to offer any correct or even plausible theory of its occurrence. Since attention was first prominently called to it, in 1823, by Velpeau, it has been much oftener noticed after compound fractures and dislocations, lacerated, contused, and gunshot wounds, and amputation of the larger limbs, than after any other accidents. In lying-in females it is also sufficiently frequent, and is, in fact, a considerable source of the mortality consequent upon the puerperal state. It has been known to supervene upon erysipelas, carbuncle, smallpox, scarlatina, and typhoid fever. One of the first cases of the disease I ever saw occurred, many years ago, in a young woman who had an attack, apparently not a severe one, of erysipelas of the leg. On dissection, I found a sufficient cause for death in a pyemic abscess in the left lung, about the volume of a large almond, filled with plastic matter, and surrounded by highly inflamed and softened pulmonary tissue. No appreciable disease existed in any other part of the body. The secondary purulent collections so often met with in glanders and dissection wounds evidently belong to this class of affections. Pyemia occasionally succeeds to the use of the trephine, the extirpation of tumors, lithotomy, lithotripsy, the perineal section for the cure of stricture of the urethra, and the operation for aneurism. Sometimes, indeed, apparently the most trifling operation is followed by it. In 1831, I attended, in consultation, a man who lost his life by blood-poisoning consequent upon bleeding at the bend of the arm; and a similar case occurred a number of years ago in my own practice at the Louisville Marine Hospital. The patient, a colored woman, laboring under chronic disease of the wrist-joint, was bled, at my request, by the resident physician, at the median basilic vein. In a few days violent phlebitis supervened, followed by large purulent collections in nearly all the great joints, as well as among the muscles of the arm and shoulder, terminating in death in less than a week. The injury inflicted in the removal of a small piece of dead bone has been known to cause death by ichorhemia. In 1848, I lost a young man, twenty-eight years of age, from pyemia, brought on by tying three hemorrhoidal tumors. Death occurred on the eighth day; and, on dissection, I found the cellular tissue of the meso-rectum studded with hundreds of abscesses, from the size of a currant to that of a small pea.

Pyemia occasionally follows the suppurative inflammation consequent upon a badly-healed stump, perhaps weeks and even months after the amputation, and long after the patient is apparently out of all danger. The discharge, perhaps never entirely arrested, suddenly increases in quantity, the parts become tender and irritable, the constitution is seriously affected, rigors soon set in, and, in short, all the symptoms of blood-poisoning are fully declared.

No period of life is probably entirely exempt from the attacks of this disease. It has been met with even in children at the breast. A case has been reported of an infant, only ten days old, in whose body, affected by erysipelas, not less than nine large abscesses of this kind had formed, causing death in a short time. On the other hand, it occasionally appears at a very advanced age. Young and robust subjects, however, have appeared to me to be most liable to it, especially after severe railway and other accidents, attended with severe shock and a good deal of loss of blood. Wounds of, and operations upon, the veins are very prone to be followed by blood-poisoning. There can be no doubt also that pyemia is more common among the inhabitants of crowded cities than among those who enjoy the benefits of pure country air, good wholesome food, and an abundance of exercise and sleep; it is likewise more frequent in hospitals, almshouses, and other receptacles for the poor than in private practice; circumstances of no little interest both in an etiological and therapeutic point of view.

Such being some of the remote causes of pyemia, the question may now be asked, What are the immediate causes of the disease, or the circumstances whose operations are more directly concerned in its production? This subject has led to much speculation; and, although it has been ably discussed by a number of enlightened pathologists, yet it must be confessed that our knowledge respecting it is still extremely meagre and unsatisfactory.

The old notion that pyemia is the product of metastasis; or, in other words, that it is due to the absorption of pus from the part originally affected, and to the transportation of this fluid to some other, more or less remote situation, where it is collected into a focus, and thus becomes a source of new irritation and disease, has still its advocates and adherents. It rests upon the supposition that the pus corpuscles are admitted, unchanged, into the open mouths of the veins at the seat of the wound, as, for example, the surface of the stump, and that, being so introduced into the circulation, and pushed onward by the blood, they are finally arrested in the minute capillaries, which are unable to transmit them, as they do the red particles of the blood, in consequence of their larger size. The mechanical obstruction thus caused forms, it is alleged, a new cause of morbid action, which is soon followed by the development of an abscess, or a deposition of pus, and, if the new depôts be numerous, by purulent infection. In opposition to this doctrine, it has been contended that pus corpuscles never gain access in this way into the circulation, and that those who profess to have seen them there were deceived by the resemblance which these corpuscles bear to the colorless globules of the blood. Moreover, it is asserted that there is nothing in the corpuscles of healthy, laudable pus of an irritating nature, and that, even supposing they got into the veins, it would not be possible for them to occasion multiple abscesses.

Cruveilhier, from some experiments which he performed on the inferior animals, as dogs, came to the conclusion that pyemia and multiple abscesses might be induced by any irritating fluid, accidentally introduced into the system, and incapable of spontaneous elimination. On injecting ink, mercury, and other substances into the blood, he found that purulent depôts occurred wherever the extraneous substance became impacted in the minute vessels. Granting that these experiments caused precisely what has been alleged of them, it is difficult to see why they should have been brought forward as a proof of the manner in which pyemia is developed in the human subject. There is certainly no similarity, hardly, indeed, any analogy, between the substances used by Cruveilhier in his experiments upon dogs and those that are formed in a suppurating wound, or on the surface of a stump after amputation.

Mr. Henry Lee, of London, in a small treatise on the origin of Inflammation of the Veins, published in 1850, advanced the ingenious, and, at first sight, very plausible, idea, that these purulent deposits are essentially due to the coagulation of the blood in consequence of the admixture of pus within the veins. He found that when healthy, recently-drawn blood was mingled with pus, it solidified more rapidly and more firmly than under ordinary circumstances; and, coupling this occurrence with the well-known fact that the veins are often obstructed by large clots in phlebitis, he concluded that coagulation must be the first link in the chain of morbid action. The inspissated blood, unable to make its way through the living body, would, Mr. Lee thinks, soon adhere to the sides of the vessels, which would thus become so many centres of inflammation and purulent deposits. It will be perceived that this theory, like that of the older pathologists, previously adverted to, rests essentially upon the idea that pus may pass bodily into the veins, or, in other words, without any change in its composition, and that it differs from it only in assuming, what is doubtless true, that it possesses the power of coagulating the blood with which it comes in contact.

Finally, there is another class of pathologists who attempt to account for the formation of purulent deposits by supposing that they are caused by the development of a peculiar poison, derived from certain kinds of pus, which, entering the circulation, contaminates the blood and solids, and thus brings about that adynamic and atonic state of the system so characteristic of pyemia. According to this doctrine, which has found one of its ablest advocates in Professor Bennett, of Edinburgh, pus corpuscles do not enter and mingle with the blood, what have been taken for these bodies by various observers being merely so many colorless cells of the blood, the distinction between the two being often extremely difficult, if not impracticable.

Of the foregoing explanations the last, it seems to me, is not only the most plausible, but also the most consistent with facts. Agreeing with its advocates that it is impossible for pus corpuscles to enter the circulation, except in the case of open-mouthed veins communicating with a suppurating surface, it is unquestionable that the more attenuated and watery parts of pus; or, perhaps, more correctly speaking, the more ichorous, sanious, or sanguinolent varieties of this fluid, frequently become commingled with the blood in suppurating wounds and in the stumps of amputated limbs, thereby speedily and thoroughly contaminating both solids and fluids, and, consequently, effectually undermining the constitution. It is not improbable that this poisonous matter, soon after its admission into the circulation, excites inflammation in the capillary vessels, as well as in some of the larger veins, rapidly followed by deposits of fibrin and pus, or the development of purulent collections. The coagula, so often met with in the veins of those who die of this disease, are a direct result of this inflammation, their formation being favored by the plasma thrown out by the inner surface of the affected vessels. The occurrence, in fact, is similar to what takes place, at times, in inflammation of varicose veins in the lower extremities of laboring people, which are occasionally completely clogged up in this way. Thus, it is not unlikely that the first link in the chain of morbid action in this affection is a poisoned and disorganized state of the blood; the second, the development of inflammation in the capillaries and veins; the third the formation of adherent coagula, clots, or concretions; and the last, as the necessary and inevitable effect of the others, a deposition of pus, or pus and fibrin.

Is pyemia always, as the name denotes, a result of the admission of vitiated secretions, or putrescent matter into the circulation? Instances occur, as when the disease complicates typhoid fever, scarlatina, and asthenic and other affections, where the reverse would seem to be the case, and yet, it must be confessed, it is not always possible, even here, to determine whether the individual is entirely free from antecedent suppurative action. It is probable that, under such circumstances, a mere disordered state of the blood, such as undoubtedly attends the worst forms of these maladies, may be quite adequate to the production of secondary abscesses of a very bad character.

The period of latency of pyemia is often, if not generally, very short, frequently not exceeding a few days from the time of the accident or operation giving rise to it. There are cases, however, in which a much longer time elapses, although they are uncommon. As a general rule, it may be assumed that the briefness of the period of latency will be in proportion to the shock of the system, the amount of hemorrhage, and the ill state of the patient's health prior to the injury. The period is usually shorter in traumatic than in idiopathic affections, in the latter of which the secondary lesion occasionally does not come on until near the time of apparent convalescence.

The approaches of pyemia are generally very stealthy and insidious; hence it often happens that the young and inexperienced practitioner is thrown completely off his guard in respect to the nature of the formidable disease with which he has to grapple. If the case is one, for instance, consequent upon an amputation, he probably feels concerned to find that the stump gives evidence of being in an unhealthy condition; that it is unusually tender and painful, that it manifests no disposition to heal, and that the discharge is not only profuse but of a thin, sanious, bloody, or ichorous nature. The patient, although not inclined to complain much, is restless and ill at ease, looking pale, sallow, and anxious, as if some serious evil were impending. His pulse is irritable and too frequent, the cheek is marked by a sinister flush, the appetite is impaired, and the secretions are deranged. This prodroma is of short duration; often hardly lasting twenty-four hours. Violent rigors now set in, which, after having continued for a period varying from fifteen minutes to half an hour, an hour, or even two hours, are succeeded by violent reaction, and this, in its turn, by profuse sweats, often completely drenching the su face and even the body clothes. These rigors may return several times in th twenty-four hours, or they may come on at regular periods, not unlike th paroxysms of an intermittent fever, for which the unwary sometimes mistak them. Their severity is not always the same; cases occur in which they a replaced, as it were, by chilly sensations, alternating with flushes of heat, an not unfrequently lasting for several days together. In whatever manner thi outbreak of the disease is displayed, the case at once assumes a more bold an decisive character. The conjunctiva and skin exhibit a well-marked icterod appearance; the features are shrunken and withered, the nose being pinche and the eye sunk in its socket; the pulse is small, frequent, and feeble; th breathing is accelerated and performed with unusual effort; the tongue is dr and clammy; the thirst is urgent; the sleep and appetite are interrupted the bowels are irregular, being at one time relaxed, and at another const pated; the stomach is irritable and nauseated; the urine is high-colored an scanty; the extremities are cold; the mind wanders; and the body is ofte racked with excruciating pain, especially in the joints and muscles, which a not unfrequently exquisitely sensitive to the slightest touch. Occasionall the patient complains of severe pain in some internal organ, to which h refers all his principal suffering. Cough is sometimes present, and when thi is the case an examination of the chest generally reveals the existence of mor or less serious lesion of the pulmonary tissues, or of the lung and pleura. A the disease progresses, red blotches, swollen, and excessively painful, appea over the larger joints, and serve as the forerunners of approaching suppuratio in their interior, as well as in the tissues immediately around them. Simil marks occasionally show themselves in the course of the principal veins an in the situation of some of the muscles, particularly the deltoid and pectora

The symptoms, long before the disease has reached this crisis, are of typhoid character, the whole system seemingly laboring under the depressin influence of a deadly poison. The downward tendency is rapidly progres ive; the machinery of life moves alternately forward and backward; th pulse becomes more and more feeble; the respiration is frightfully oppressed the body is remarkably emaciated; and the patient lies in a comatose co dition, from which he is destined never to awake. This, however, is not un formly the case; for the instances are not infrequent, where the mind retain its consciousness almost to the last. The period at which death occur after the disease has once fairly commenced, varies from three to ten day or a fortnight, the average being about one week, or perhaps a little under.

Although there are, strictly speaking, no pathognomonic symptoms pyemia, yet it is seldom that any one who has ever seen a case of this diseas or who has made himself thoroughly familiar with its history and progres can possibly confound it with any other complaint. Its very mode of inv sion generally sufficiently stamps its true character. The sudden, violen and unexpected rigor; the unhealthy character of the suppurating sore wound, if any exist; the icterode and shrunken state of the features; th rapid supervention of typhoid symptoms; the great mental anxiety and e cessive restlessness; the horrible aching pains in the joints, limbs, and othe regions; and, lastly, the rapid abduction of the fat, leaving the body in wasted and emaciated condition, far beyond what occurs in almost any othe affection, excepting, perhaps, cholera; are signs which, if they do not une ringly mark the nature of pyemia, will always excite the serious suspicion the attendant, and induce him to scrutinize his case in the most careful an thorough manner. The only disease with which blood-poisoning is liable t be confounded is intermittent fever; but here the distinction is so easil drawn as to render mistake impossible, unless the most stupid carelessness i evinced by the practitioner. The diagnosis of traumatic pyemia will, i general, be less difficult than that of the idiopathic variety, or that arising from internal causes; for the violent rigor, the icterode countenance, and the rapid prostration and emaciation will usually afford sufficient characteristic evidence of the nature of the complaint to prevent mistake.

The dissection of patients dead of pyemia reveals, as might be supposed, important and interesting changes both in the solids and in the fluids. Of those affecting the solids, the most constant are abscesses and purulent depôts in various organs, cavities, and tissues. The former, generally known under the name of *metastatic*, or multiple abscesses, are most common in the lungs and liver, then in the spleen, and, lastly, in the brain, heart, and kidneys. They sometimes occur in the subcutaneous cellular substance, and beneath the peritoneum. In one instance, previously referred to, I found an immense number in the areolar tissue of the meso-rectum. Their presence has also been detected in the prostate gland.

In regard to their number, metastatic abscesses vary in different instances. It is seldom that we find only one; most generally there are as many as twenty, thirty, fifty, or even a hundred. Sometimes, indeed, the surface of the affected organ is completely studded with them, more than a thousand having been observed in a single case, principally in the deep-seated viscera. The size of this abscess is also very variable. Some do not exceed that of a hemp-seed or garden pea; while others are as large as a hazelnut, a marble, a pigeon's egg, or an orange. When very numerous, they are usually proportionably small. In their figure they are generally oval, spherical, or angular; sometimes remarkably irregular. When seated near each other, they occasionally become confluent, like the pustules of smallpox.

The contents of a metastatic abscess are seldom of the nature of well-elaborated pus; on the contrary, they are almost always of a semi-concrete consistence, of a dirty grayish, cineritious, or drab color, and composed mainly of aplastic lymph. This is particularly true of recent cases; in those of longer standing, the contents are more decidedly purulent, but even then they are often blended with grumous blood and flakes of fibrin.

The textures immediately around the abscess may be natural, or variously altered in their appearance and consistence. In most cases they are engorged with blood, heightened in color, softened, or converted into a pulpy diffluent substance. The coats of the vessels are inflamed, thickened, and infiltrated with serosity, while their canals are filled with pus, semi-fluid blood, or fibrinous concretions. The capillary veins usually participate in the inflammation.

Purulent collections, as a consequence of ichorhemia, are most frequently met with in the chest, being rare in the peritoneal cavity, the arachnoid, and pericardium. The reason of this difference seems to be due to the fact that the lungs nearly always suffer whenever there is serious involvement of the system, whereas the abdominal viscera, heart, and brain, commonly escape in this case.

Professor Sédillot, of Strasbourg, who has studied this disease with great care, and who has combined the results of his observation in a highly instructive and interesting monograph, published in 1849, remarks that in 100 cases of pyemia, we should find the lungs affected in 99; the liver and spleen in 1 of 12, the muscles in 1 of 15, and the heart and peripheric cellular tissue in 1 of 20: the brain and kidneys suffering comparatively seldom.

The joints often suffer very severely. In some of the cases which I have had an opportunity of examining after death, matter was found in nearly all the larger articulations, and also in quite a number of the smaller ones. In many cases the pus is situated on the outside of the joints, as well as within.

Large collections of purulent fluid are sometimes discovered in the subcutaneous and intermuscular areolar tissue; the veins also occasionally contain a considerable quantity, either lying free in their cavities, or, as is more common, commingled with the blood in the interior of fibrinous concretions.

The pus which occurs in these various localities is of the same nature as that which is contained in metastatic abscesses, properly so termed, that is, it is ill-elaborated, and intermixed with a large proportion of aplastic material. Both in the veins and in the intermuscular areolar tissue, it is generally, as just stated, interspersed through fibrinous concretions, coagula, or blood-clots, giving the latter a peculiar appearance, as if they were pervaded by small specks of lymph, or lymph and pus.

The prognosis of pyemia is most unfavorable; few patients recover, and these, for the most part, remain for a long time in a debilitated and crippled condition, liable to other attacks of disease from the slightest causes. As already stated, death usually occurs within the first week after the commencement of the malady, being apparently dependent upon the severe exhaustion consequent upon the excessive pain and obstructed circulation, which form such conspicuous features in the progress of this affection. In most cases a return to health is announced by the appearance in the urine of an unusual quantity of lithic acid.

Treatment.—In the treatment of ichorhemia two indications present themselves to the practitioner, and these should, throughout, receive his most earnest and faithful attention. These are, first, the removal of the exciting cause of the disease; and, secondly, the support of the system, in order to enable it, if possible, to shake off the toxical influence under which it is so plainly laboring.

If the disease has been induced by an accident or operation, attended with an open, suppurating surface, much may be done, in many cases, by the promotion of cleanliness, to prevent further mischief from the ingress of purulent fluid. This object is best attained by diligent, almost incessant attention to the dressings and position of the part, the former being frequently changed, and the latter so arranged as to favor the escape of the secretions as fast as they take place. Detergent lotions are often serviceable, especially if they contain chlorinate of soda, but care must be taken that they are not so strong as to irritate, and it will be well, particularly if we have to deal with a foul stump, to throw them freely upon the parts with a large syringe, as this exerts a much better and wider influence than mere irrigation with a sponge. It will also be advantageous to keep the dressing constantly sprinkled with the chlorides, both with a view to allay fetor and to purify the air of the apartment, which must be frequently renewed by opening the doors and windows.

To prevent the further ingress of purulent fluid into the system, is not so easily accomplished, if, indeed, it can be accomplished at all. If the surface is not too extensive, I should strongly advise the free use of a mixture of one part of the solution of acid nitrate of mercury and two parts of water, applied rapidly with a mop, the intention being not so much to produce an escharotic as an alterant effect, thereby inviting a rapid change in the action of the capillary vessels and an abundance of exudation matter, so as to close up the mouths of the vessels, and cause consolidation of the affected tissues generally. When the vessels are large and patulous, they may sometimes be closed by well-regulated methodical compression, care being taken that this is applied in as gentle and uniform a manner as possible. The actual cautery, recommended by the French surgeons, for sealing the suppurating surface, has met with few advocates anywhere, and should never, I conceive, be employed for this purpose, unless it is drawn over the parts in the most careful and considerate manner, the surface being previously well wiped with soft linen to divest it of its moisture.

The second indication is best fulfilled by stimulants and tonics, as brandy, habit of body, was originally employed to designate the peculiar train of phenomena attendant upon pulmonary phthisis, of which it forms so remarkable an attribute as to have attracted the attention of practitioners in all ages. It is, however, no longer restricted to such narrow limits; for the group of symptoms which it serves to characterize follows a great number of diseases, accidents, and operations, and, therefore, claims the special consideration alike of the surgeon and the physician.

Hectic fever never occurs, as was once supposed, as an idiopathic affection; on the contrary, it is always symptomatic of some particular disease, generally of the presence of profuse discharge, as of pus or blood, or the development of an abscess in some important structure, as the brain, lung, or liver. One of the most remarkable circumstances connected with its history is, that it rarely, if ever, appears until the malady which it serves to represent has made considerable progress, or induced serious structural changes, along with grave inroads upon the constitution. Thus, in phthisis, it is seldom witnessed until softening of the tubercular matter is about to take place, sometimes, indeed, not until pretty large cavities have formed; on the other hand, there are cases, as in psoas abscess, where pus frequently exists in large quantity, perhaps, for several months, and yet none of the ordinary signs of hectic fever arise. Serious as the local disease apparently is, the general system does not seem to be disposed to take any particular notice of it; the pulse, sleep, appetite, bowels, and secretions all go on in nearly their accustomed manner; and, if there be any loss of flesh and strength, the alteration is so gradual and imperceptible as almost to elude the attention even of the patient himself. But sudden and often most alarming changes occur in the constitution if, in consequence of a large opening, air is freely admitted into the cavity of such an abscess, causing decomposition of its contents. The shock is violent, and resentment of the injury is close at hand; soon a severe rigor comes on, lasting, it may be, several hours, when it is succeeded by violent fever, as this, in its turn, is followed by copious sweat. Such is not unfrequently the commencement of an attack of hectic fever, a bad habit of body, which often ceases only with the patient's life. Thus, it will be perceived that hectic fever, like every other form of fever, at least so far as we can comprehend its nature and type, is not a disease, but a symptom of disease, an expression of general suffering, dependent upon some special local lesion, not always, perhaps, appreciable by our senses, yet, nevertheless, in active operation, and effectually accomplishing its work.

In traumatic affections, hectic fever often sets in at an early period after the accident; perhaps there may have been grave shock, and profuse hemorrhage, and the two are soon followed by copious suppuration, which thus still further undermines and exhausts the vital powers; or it may be that more or less of the pus has been carried into the circulation, and that the whole system has become poisoned by the unfortunate admixture, every blood cell and every fibre and atom of solid matter feeling the baneful influence. The brief struggle which ensues may be characterized by the inflammatory type; but this is evanescent, hectic soon taking its place, and thence on steadily maintaining the ascendency, no intercurrent circumstances ever changing its real character, although they may temporarily disguise it, or for a time keep it in abeyance.

Hectic, then, is a continued, remittent fever, lasting generally as long as the cause which induced it lasts; subject to distinct paroxysms of exacerbation and remission, but at no time, perhaps, completely absent, although apparently it may be. Its outbreak is often sudden and violent, sweeping over the system with the fury of a hurricane; at other times, and more generally, it creeps on gradually and stealthily; in the former case, it is marked by severe rigors, in the latter merely by a sense of chilliness, or slight horripilations. Whatever may be its mode of attack, its actual invasion is always preceded by more or less indisposition, amounting ordinarily to a mere state of malaise, or a feeling of lassitude and discomfort, which the patient struggles in vain to throw off. His appetite and sleep are impaired; his tongue is inclined to be dry, perhaps somewhat coated; more or less thirst exists; and there is often considerable fever, either of the inflammatory, irritative, or typhoid type. In short, hectic, like every other fever, passes through a stage of incubation, brief in one case, protracted in another. The crisis being attained, the chill appears, and thus the disease is fairly inaugurated; taking its position in the system, which, as already stated, it never abandons until the removal of the exciting cause, and often not then.

The febrile exacerbation is usually vesperal, coming on late in the afternoon, or early in the evening; lasting, on an average, from six to nine hours, and then gradually going off, to reappear, in a similar manner, about the same time the next day, thus giving the disease a distinct periodical character, not unlike that of an ordinary intermittent. Not unfrequently there are two paroxysms in the twenty-four hours; one in the evening, and the other perhaps late at night, or during the course of the morning; the latter being generally much the milder of the two. The chill ushering in the fever is often very long and severe, the patient occasionally shivering for several hours, his teeth chattering violently, and the whole body feeling as if it were wrapped in ice; at other times, as already intimated, the sensation of cold is very slight, and perhaps perceived chiefly along the spine, shoulders, and lower extremities, its duration being variable, now short, now quite protracted. The chill passing off, reaction succeeds, usually violent in proportion to the previous depression, and gradually, sometimes suddenly, merging into a profuse sweat, the harbinger of returning ease and comfort. All the secretions are again unlocked; the mouth regains its moisture; the urine is poured out in increased quantity; the thirst rapidly subsides; the pulse becomes soft and comparatively calm; and ere long the poor patient, tortured and racked with suffering, sinks into a tranquil and refreshing sleep.

In the interval of the paroxysms, the patient, although comparatively comfortable, is by no means entirely free from .excitement. The pulse, in particular, is always preternaturally frequent, often even quick and small; seldom entirely normal in any case or at any time; easily disturbed by exercise and mental emotion. The countenance exhibits well-marked evidence of the inward trouble; in the morning it is pale, shrunk, and careworn; in the afternoon, on the contrary, it has generally a somewhat full appearance, and a circumscribed blush, too plainly denotive of the vital decay, rests upon the cheeks in striking and often mournful contrast with the surrounding pallor. The eyes have a peculiar lustrous expression, and gradually retreat more and more within their sockets. Emaciation begins early, and is steadily progressive, proceeding from bad to worse, until the body is literally wasted away to a skeleton. Amidst all these evidences of decay, it is remarkable how well the appetite frequently sustains itself; the patient often eats voraciously in the intervals of his paroxysms, and digestion goes on with little or no interruption, assimilation alone being at fault. The tongue is variously affected; in general, however, it is clean, or nearly clean, but, perhaps, a little too red at the tip and edges. At times it is remarkably smooth and glossy; and cases occur in which it appears to be glazed, as if it were coated with a thin layer of mucus. A foul tongue is a rare phenomenon in this form of fever. Hectic patients are usually easily impressed by atmospheric vicissitudes; the slightest exposure produces chilliness, and hence they always require an unusual amount of clothing. The feet and legs, in particular, are nearly incessantly cold; the hands, on the contrary, are generally dry, hot, and burning.

As the disease occasioning the hectic progresses, the symptoms gradually manifest more and more of a downward tendency; the appetite fails, the sleep is interrupted, the perspiration becomes more profuse and exhausting, aphthæ make their appearance upon the tongue and fauces, and the bowels are constantly harassed with diarrhœa, the discharges being thin, watery, and excessively fetid. Thus, the case goes on, steadily but almost imperceptibly, from bad to worse, until the patient dies literally exhausted from the want of nourishment, and perhaps also in consequence of the severity of his bodily pains. During all this struggle, it is astonishing to see how the mind, rising above the mortal decay around, maintains its supremacy; being not only clear and strong, but hopeful and often even sanguine to the last.

The prognosis of hectic fever is influenced by such a variety of circumstances as to defy anything like a definite statement. In general it promptly disappears with the removal of the exciting cause, provided the inroads made by that cause have not been productive of any serious disorganization; should this have happened, the case will probably have an unfavorable issue, the hectic continuing in a modified form down to the fatal crisis. The fortunate manner in which hectic disappears after the removal of the disease that occasioned it, is much more frequently witnessed by the surgeon than the physician, whose practice more generally brings him in contact with all kinds of incurable organic maladies. I have repeatedly seen a severe and protracted hectic, consequent upon the disorganization of a tuberculosed joint, completely vanish in less than twenty-four hours after the removal of the limb, and the system rapidly recover from the effects of the previous disturbance.

The indications in the treatment of hectic fever plainly are, first, to remove the exciting cause, and, secondly, to support the system until time is afforded to it to shake off the effects of the morbid action.

The first of these objects is frequently best accomplished by the knife, as when the disease depends upon, and has been kept up by, a tuberculosed joint, or a suppurating compound fracture, the removal of which often promptly restores health and tone to the prostrate system. If the cause be inaccessible, the case must be treated upon general principles, in the hope that, by and by, as the strength improves, the patient will have sufficient recuperative power to dislodge the source of irritation, and so rid himself of his malady.

The second indication is to be fulfilled by tonics, nutritious food, anodynes, the suppression of unnatural discharges, change of air, and attention to cleanliness.

The use of tonics is generally indispensable in almost every case of hectic, however induced, particularly in its more advanced stages, when there is a wretchedly impoverished condition both of the blood and solids. The articles most to be relied upon are quinine, Huxham's tincture of bark, and the different preparations of iron, of which, according to my experience, the sulphate and the tincture of the chloride deserve the preference. Whatever substance be selected, its operation should be aided by a nutritious diet, consisting of the richer kinds of animal broths, jelly, tapioca, arrowroot, and milk, with brandy toddy, wine whey, ale, or porter. When the emaciation is steadily progressive, and dependent upon a tubercular diathesis, the use of cod-liver oil is indicated, and should be given in as large doses as may be consistent with the tolerance of the stomach.

Anodynes are among our most valuable agents in the treatment of hectic, as they serve to allay the inordinate action of the heart, to relieve pain and irritation, and to procure sleep, which is generally so much impaired in cases of this kind. They should be given in full doses, not too often repeated; and the best period for their exhibition is usually towards bedtime, so that their appropriate effects may be realized during the night in refreshing tranquillity. Morphine will generally be found to be borne better than opium, but when there is much sweat or diarrhœa it may often be advantageously replaced by the latter, as more likely to produce an astringent influence.

The exhausting effects of diarrhœa and perspiration, especially when they are of a colliquative character, must be promptly counteracted by suitable remedies, of which opium, as just stated, is one of the best. When the diarrhœa is dependent upon vitiated fecal matter, a mild laxative should be given, and blue mass, or calomel, in minute doses, if it has been caused by derangement of the biliary secretion. Sometimes it is most readily checked by astringents, as rhatany, prepared chalk, or tannin, in union with an anodyne.

Night sweats, which are often a source of so much prostration, will be best met by the free use of aromatic sulphuric acid, tannate of iron, or oxide of zinc, with frequent ablutions of the surface with tepid alum water. Sometimes they may be effectually prevented by a full opiate administered a short time before the expected rigors.

Whenever the local disease, inducing the hectic, will admit of it, exercise should be taken in the open air, which frequently conduces more to the restoration of the patient's appetite and strength, and the relief of the colliquative diarrhœa and sweats, than all other means combined. Children may be carried about in their nurses' arms, or in hand cars, while adults may ride about in a carriage, or walk, as may be most agreeable and convenient. Occasionally a residence at the seaside will be found to be eminently beneficial.

Finally, the greatest attention should be paid to cleanliness; the body should be frequently washed and rubbed; the excretions carefully and promptly removed; and the apartment thoroughly ventilated at least twice a day.

SECT. V.—HEMORRHAGE.

A discharge of blood, as an effect of inflammation, is, on the whole, an uncommon occurrence. It may take place in the interstices of the organs and tissues, or upon their free surfaces, and is generally a result of the rupture of some of the vessels of the part, in consequence of the manner in which the blood is sent into them by the heart, at a time when their walls, weakened by the morbid action, are incapable of offering much resistance. It is probable that, when the blood is in a dissolved condition, as occasionally happens in scurvy, typhoid fever, and other low states of the system, the hemorrhage may occur as a product of secretion, or, perhaps, rather as a mechanical transudation, the fluid percolating through the coats of the vessels as water does through a bladder, the globules passing off in an altered and disintegrated form.

The fluid may present itself in a pure state; but, in general, it is mixed with other morbid products, as serum, lymph, pus, and mucus, which may thus essentially modify its properties, if not, in a great degree, mask its character. The quantity of the effused blood varies, in different cases and under different circumstances, from a few drops to a number of ounces. The largest hemorrhages of this kind commonly occur in connection with the serous and mucous surfaces, and the subcutaneous and intermuscular cellular tissue, especially in diffuse erysipelas, and in inflammation consequent upon snakebite, in the latter of which the dissolved state of the blood powerfully predisposes to the extravasation. In scorbutic affections, where a somewhat similar condition of the fluid exists, inflammatory hemorrhages are by no means infrequent. Considerable effusions of blood occasionally take place in the air-cells of the lungs and the minute bronchial tubes in pneumonitis.

In dysentery, a discharge of blood and mucus is one of the characteristic symptoms of that disease.

Inflammatory hemorrhage rarely comes on until the action of which it is a product has made considerable progress; hence its appearance may generally be regarded as denotive of a higher grade of excitement than a mere deposit of serum, plasma, or even pus. When the discharge is copious, it may, provided it do not go too far, prove serviceable in the way of depletion, answering pretty much the same purpose as local bleeding by leeching, scarification, or puncture. In general, however, it is too small to confer any substantial benefit in this way; while, on the other hand, if it be very copious, it may speedily lead to fatal exhaustion, or, at all events, to such a degree of depression as to interfere materially with recovery. Besides, it may cause serious mechanical obstruction, as when it is effused into the interstices of organs, thus sadly impeding their functions.

In the treatment of inflammatory hemorrhage our reliance is to be placed mainly upon the ordinary antiphlogistic measures, employed more or less vigorously according to the exigencies of each particular case. If the discharge be at all copious, so as to threaten exhaustion, recourse may be had to the administration of acetate of lead in union with opium, and injections of the same article, or, what will be better, of the perchloride of iron, a substance which possesses a remarkable controlling influence over all kinds of capillary bleeding, whether inflammatory or otherwise. They must, however, be used with great caution, otherwise they may do harm by their irritating nature, thus adding fuel to the flame. Sometimes the discharge may be readily arrested by cold applications, as cloths wrung out of ice water, and frequently renewed, or by the steady employment of a bladder partially filled with pounded ice, or some refrigerating lotion. When the blood has been poured out into the cellular tissue beneath the skin, or among the muscles, and acts injuriously by compressing the capillary vessels, nothing short of early and free incisions will be likely to avail. When the hemorrhage is internal, proceeding from a serous membrane, as the pleura, or peritoneum, sorbefacient remedies are indicated; but, these failing, as they will be likely to do, when the deposit is uncommonly large, evacuation must be attempted with the trocar, although such a proceeding will generally be extremely hazardous, to say nothing of its inefficacy in case the effused blood has undergone coagulation, rendering its escape impracticable.

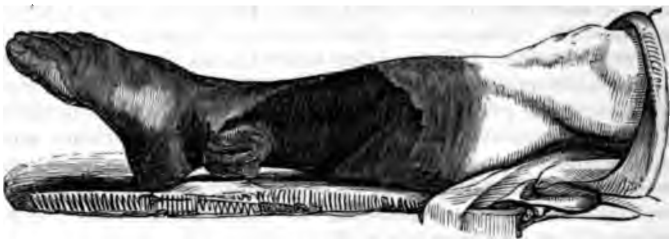
SECT. VI.—MORTIFICATION.

Mortification may be defined to be the death of a part, the rest of the organism retaining its vitality. The word, as usually employed in this and other countries, is synonymous with gangrene, so much in vogue among French writers. Formerly the term gangrene was used to denote that state of a part which immediately precedes its dissolution, while sphacelus was employed to signify the complete extinction of life, without any possibility of its recovery. When we speak of the death of a bone, necrosis is the expression generally used. It would save much trouble, and prevent confusion, if all these terms, excepting the first, were abolished.

Mortification may be acute or chronic, moist or dry, common or specific, according to the rapidity of its progress, the condition of the dead part, or the nature of the exciting cause. There is really no material difference between acute and moist mortification, or between dry and chronic, and hence these terms may very properly be employed in a convertible sense. The word specific implies the operation of a peculiar virus in the production of and death, already actively engaged at the focus of the inflammation, soon accomplishes its work.

Mortification from intensity of action is generally very rapid in its progress, a large amount of tissue, and sometimes even an entire limb, perishing in the course of twenty-four hours from the commencement of the process. Some of the most characteristic forms of this species of gangrene are met with in compound fractures and dislocations, in lacerated, contused, railway, gunshot, and poisoned wounds, in burns and scalds, in carbuncle, and in erysipelas, in which the tissues often succumb under the resulting inflammation with amazing rapidity. Hence, such cases, of which fig. 17 affords an excellent illustration, are generally said to be acute; and, as the parts are always infiltrated with an abundance of fluids, the term "moist" is also often used to designate them.

Fig. 17.



Acute mortification, rapid in its progress, and attended with much swelling and moisture.

II. Mortification from *mechanical obstruction* of the circulation may be caused by direct injury to the arteries, or indirectly through disease of the heart, interrupting the flow of blood to the part. The operation of tying the femoral artery for the cure of aneurism of the popliteal, is occasionally followed by mortification of the foot and leg; and the same accident sometimes happens from the pressure which a tumor of this kind exerts upon the terminal branches of this vessel. The circulation being thus impeded, inflammation, generally of a very active kind, is liable to be awakened, which soon overpowers the affected tissues. Laceration of the principal artery of a limb often results in the death of the structures which it supplies with blood. Disease of the valves of the heart, leading to vascular engorgement of the feet and legs, along with œdema of the subcutaneous cellular tissue, not unfrequently produces similar effects. Tight bandaging, pressure of the body from protracted decubitus, and inordinate constriction of the bowel, in strangulated hernia, are so many causes of mortification from interruption of the circulation.

III. The influence of *chemical agents* in producing inflammation and mortification is exemplified in various ways. The contact of the alkalies and acids, if very slight, will, in general, cause merely a rubefacient effect; if more severe, it will induce vesication; while, in its worst form, it will occasion instantaneous destruction of the tissues. The application of heat and cold acts very much in the same manner. In all these cases life is destroyed, either by the primary impression of the chemical agent, or as a consequence of the violence of the resulting inflammation. In persons of feeble organization, especially in young children impoverished by starvation and disease, the application of a common blister is often followed by extensive sloughing; and a similar effect is occasionally witnessed as a result simply of the protracted use of a mustard plaster. The infiltration of urine in the cellular tissue of the perineum often produces wide-spread gangrene

When acute inflammation is about to terminate in mortification, there is, in general, a sudden aggravation of all the previous *symptoms*, both local and constitutional. The pain and sensibility become more keen and intolerable, the redness assumes a more vivid aspect, the swelling and tension materially increase, effusion is unusually active, and functional disorder is at its maximum. If sores or wounds exist, all discharge generally ceases. Along with these local phenomena, there is marked augmentation of the constitutional trouble; the fever is excessive, the pulse is frequent, and often quite strong, the thirst is intense, and there is great restlessness, commonly with more or less delirium. The type of the constitutional symptoms exhibits much diversity. In young and robust individuals it is generally of a sthenic character, or denotive of strength; but, when the disease has been unusually violent, or the system has sustained a serious shock, whether from the present attack, or from previous suffering, it is commonly indicative of prostration, the tongue and mouth being dry, the pulse frequent and feeble, the stomach irritable, and the surface bathed with cold perspiration.

The complete cessation of vitality is denoted by the livid, black, or mottled discoloration of the part, supposing that the mortification is external; by all absence of heat and sensibility; by a peculiar fetid, or cadaverous odor; and by more or less crepitation, in consequence of incipient decomposition. Immediately beyond the seat of the mortification the ordinary phenomena of inflammation are still visible; the surface being of a scarlet hue, hot, dry, tumid, and painful, the dead and suffering parts being usually insensibly blended or marked off by a faint, indistinct line.

The part having actually died, the general symptoms are no longer of an equivocal character, whatever they may have been during the previous struggle. They are clearly of a typhoid nature, and, consequently, fully denotive of the exhausted condition of the system. The pulse is small and feeble, and from one hundred and forty to one hundred and sixty a minute; the surface, bathed with a cold clammy sweat, has a yellowish, withered appearance, and exhales a peculiarly disagreeable odor, not unlike that of moist earth; the respiration is short, hurried, and difficult; the countenance is pale and shrunken; the eyes are devoid of lustre and sunk in their sockets; the nose has a singularly pinched appearance; the lips are incrusted with dark scabs; the tongue is dry, contracted, and covered with a thick blackish fur; the abdomen is tympanitic; and there are frequent twitchings of the tendons, with hiccough, and low, muttering delirium. The strength is so much exhausted that the patient cannot sustain himself upon his pillow, but constantly sinks down in the bed; the stomach is harassed with nausea, and occasionally with bilious vomiting; and, towards the last, there are often involuntary discharges from the bowels, with retention of urine.

The cause of this depressed condition of the system is probably twofold. In the first place, it may be supposed to depend upon the shock which such an occurrence must necessarily inflict upon the great nervous centres; and, secondly, upon the absorption of vitiated matter, which, by its union with the blood, contaminates both solids and fluids, rendering them thereby incompetent for the discharge of their appropriate functions.

The *color* of the mortified parts varies in the different organs and tissues. The skin, as already remarked, is usually purple, black, or mottled, while the cellular tissue beneath it generally retains, in great measure, its normal complexion, unless, as sometimes happens, it has been infiltrated with bloody matter, when it will, of course, be of a reddish or modena color. The aponeuroses, muscles, tendons, nerves, vessels, cartilages, and bones, undergo very little change in this respect. In mortification of the lungs, the color is black; of the brain, grayish or ashy; of the liver, reddish or yellowish. The serous membranes are commonly of a purple tint, and the mucous of a at first, unhealthy, ichorous, or sanguinolent, and irritating; by degrees, however, it assumes a more favorable character, and at length acquires all the properties of laudable pus. The fetor is generally most horrible, sickening, and overpowering; tainting the atmosphere of the apartment, and exerting a most prejudicial effect upon the patient, unless prompt and effectual measures are adopted for its correction. The emanation is, of course, rather from the dead parts, now called a slough, than from the gap, or trough, which lies between them and the living. As the separation progresses, granulations gradually spring up along the raw border, exhibiting the usual appearances of healthy bodies of this kind in other situations, and furnishing an abundance of thick, yellowish pus, which, while it serves to shield them from the rude contact of the air, affords the surgeon an excellent opportunity of judging of the nature of the ulcerative action, or, in other words, of the state of the part and system.

While these changes are going on between the dead and living parts, for the riddance of the former, and the benefit of the latter, all the ordinary phenomena of inflammation are plainly visible in the structures above the breach, nature being busy in throwing up her walls of defence by pouring out a liberal supply of plastic matter into the meshes of the cellular tissue. In this way, the surviving structures are solidified and fortified against the ingress of air, and also, at least in some degree, against the absorption of pus.

The manner in which the vessels are closed during the progress of mortification, so as to prevent them from parting with their contents during the act of sloughing, is curiously interesting, and well calculated to elicit admiration. As was before stated, both the arteries and veins possess a wonderful conservative power, by which, at least in many cases, they are enabled to maintain their vitality in the midst of the dead and perishing structures. At length, however, they also yield to the devastating influence, but before this is fully accomplished their contents coagulate, and becoming firmly adherent to their inner walls, the vessels are thus, as it were, hermetically sealed. Hence, during the sloughing process it is impossible that there should be any bleeding; and for the same reason there is often no hemorrhage whatever during the artificial section of the part, inasmuch as the clots of blood frequently extend many inches beyond the line of demarcation.

Treatment.—The treatment of acute mortification is to be conducted upon the general principles applicable to that of inflammation. When this event is about to occur in a person of strong, robust habit, with a vigorous pulse, and a red, fiery, and painful condition of the part, the indication is to draw blood by venesection and leeching, to make free use of the antimonial and saline mixture, along with a sufficiency of morphia to allay pain and quiet the heart's action, and to cover the affected surface with a large blister, to paint it with iodine, or to keep it constantly wet with saturnine and anodyne lotions, either tepid or cold, as may be most agreeable. When the local action is accompanied with severe swelling, punctures, scarifications, or incisions should be made, freely and early, in order to afford vent to effused fluids, to relieve congestion, and to moderate pain and tension. The approach of gangrene may often be averted, or, at all events, materially checked, by the timely use of a blister, large enough to cover in not only the whole of the inflamed part, but also a portion of the healthy skin, and retained sufficiently long to effect thorough vesication. I am satisfied, from observation, that there is, in general, no more efficient remedy, and I therefore rarely ever omit its employment. It is particularly valuable in the idiopathic form of the disease, although it is not without its benefit in the traumatic. I was first led to use it from its great efficacy in erysipelas, where it unquestionably very frequently averts the occurrence of gangrene altogether, and it is well known acid, or the solution of the chlorinate of soda; pieces of lint wet with any of these substances being laid in the gap, and kept in place by the cataplasm.

When the sloughs are tardy in separating, advantage may be derived from the use of the knife, but care must be taken, in making the dissection, not to interfere with the living tissues, much less to lay open any important vessels. For want of due precaution in performing this little operation, much suffering is sometimes entailed, and I have witnessed several cases where the patient was absolutely destroyed by it; for, when the powers of life are greatly reduced by the effects of the gangrene, the most insignificant bleeding and the most trifling shock may prove fatal.

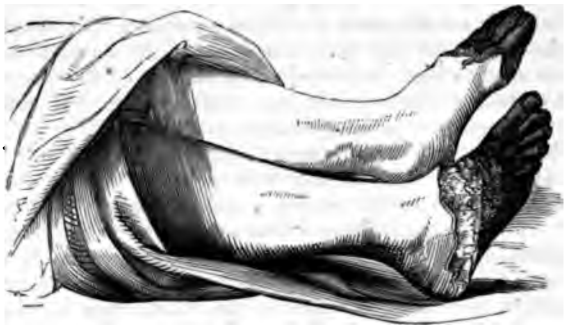
Clearance having been effected of the dead and putrid mass, the next object is to promote the granulating process, by the steady use of emollient and soothing dressings; aided, if necessary, by the nitric acid lotion, the nitrate of silver, solutions of copper, lead, or zinc, the balsam of Peru, the tincture of benzoin, and similar articles. Proper attention must also be paid to the state of the system, every effort being made to rebuild it by the judicious administration of tonics, along with nourishing food and change of air. As soon as the granulations begin to assume a healthy aspect, as indicated by their florid color, and the thick, yellowish character of the discharges, the healing process will generally progress best under the most simple dressings, serving merely as protectives against friction and rude exposure; as, simple cerate, or a light linseed poultice. If the sore be large, cicatrization may be promoted by touching its edges lightly once a day with solid nitrate of silver, and drawing them gently together with adhesive strips.

In connection with this subject the question of *amputation* necessarily arises. Under what circumstances is this operation necessary or proper? Should it be performed while the mortification is still in progress, or should it be postponed until it is completely arrested, and a line of demarcation is formed? These are important points, and they should therefore receive due consideration in every case; for it is the solemn duty of the surgeon not only to save the life, but also, if possible, the limbs of his patient. His object should ever be to preserve, and not to mutilate; for it is a thousand times more creditable to his skill and judgment to save one extremity than to lop off a hundred, however adroitly it may be done.

In attempting to settle this question special reference must be had to the nature of the mortification, or the causes under whose influence it is developed; for experience has shown that the two forms of the disease generally require different treatment. Thus, in idiopathic gangrene the rule now is never to amputate until the surgeon is assured, by the establishment of a circle of demarcation, that both the part and system are in a condition to bear the shock of the operation, and that death has been completely arrested. Even further delay may be demanded, if, upon careful investigation, it be found that the patient is still feeble from the effects of the mortification; that he looks pale and wan; that he has a weak and shattered pulse; in short, that everything is denotive of a broken state of his constitution. To amputate under such circumstances would greatly endanger the result, if not positively destroy the patient; proper allowance must also be made for the loss of blood and the shock which must of necessity follow the use of the knife, both of which, even when the greatest care is taken in performing the operation, are often most serious. If, on the other hand, the powers of the system are sufficiently active, if there is no apparent contamination of the fluids and solids, and, above all, if nature is making a vigorous effort to arrest the extension of the malady, there is no reason for delay, and hence the sooner the offensive parts are removed the more likely will the case be to have a favorable termination; the system is prepared for the emergency, and will soon react from any depression that may ensue from the employment of the knife.

cation begins at several toes simultaneously, or in pretty rapid succession; and I have met with several cases where it first showed itself upon the heel and instep. However this may be, the part always exhibits a characteristic appearance; it is perfectly dry and withered, cold, insensible, odorless, or nearly so, and as black as charcoal, the limb looking as if it were unnaturally small, as, in fact, it generally is. During the progress of the mortification, especially if this be somewhat rapid, the skin has occasionally a mottled, purplish aspect, owing to the coagulation of the blood in the superficial veins.

Fig. 19.



Chronic gangrene of the feet, the disease being arrested, and the parts undergoing separation.

The disease is usually preceded and accompanied by pains in the toes and foot, darting about in different directions, and liable to nocturnal exacerbations, preventing sleep, and rapidly undermining the general health. These pains, which are of a burning, scalding, or stinging character, are often referred by the patient to the effects of gout or rheumatism, particularly if he was formerly subject to attacks of that nature; they always increase with the spread of the malady, and demand the free use of anodynes for their suppression. The dependent posture commonly aggravates them, but, in a case which I saw not long ago with Dr. Levis, of this city, the suffering was immensely increased whenever the limb was elevated even for a few moments, and where, consequently, the patient, an old man of eighty-three, was constantly obliged, during the day as well as the night, to let his foot hang down. In some instances, the attendant pain is extremely slight. Considerable swelling is sometimes present in the part, above the site of the mortification; and cases occur, although they are rare, in which the whole extremity is oppressed with œdema, being exquisitely sore, of a pale rose color, and pitting deeply under pressure.

Well-marked *constitutional symptoms* attend this complaint, usually from the very first, and sometimes even before there is any local evidence of its presence. They are either of an asthenic type from the beginning, or they soon become so. The pulse is feeble and upwards of one hundred and twenty in the minute, quick, sharp, and irritable. The tongue is coated with a brownish fur, dry, and more or less tremulous; the appetite is impaired; the bowels are costive; the alvine evacuations are fetid; the urine is scanty and high-colored; the sleep is interrupted by pain and frightful dreams; the strength rapidly declines; and the patient gradually dies from sheer exhaustion, the period between this event and the commencement of the attack varying from six weeks to three or four months.

This form of gangrene occurs in both sexes, and probably with nearly equal frequency, although it was formerly supposed to be more common in men than in women. It is observed in all classes of individuals, the rich and the poor, the idle and the industrious, the temperate and the dissipated. Nearly all the cases, probably about thirty, that have come under my notice occurred among the middle and poorer orders of the community. Mr. Pott was of opinion that the disease was peculiar to the old, but subsequent experience has shown that it may take place at different periods of life; and within the last fifteen years a number of cases have been reported where it occurred in children under ten years of age. It has been conjectured that a gouty and rheumatic temperament predisposes to the development of the affection, and there are numerous facts upon record which would seem to countenance such an idea. Again, it has been asserted that particular modes of life, as indolence and huge feeding, powerfully contribute to its production.

From the form of chronic mortification which we are now considering few patients recover. If occasionally one escapes, it only forms an exception to the rule. In most cases, the disease proceeds steadily, or, with an occasional temporary interruption, to a fatal termination. Now and then, when the powers of life are not too much exhausted, nature makes an effort to arrest the morbid action by the formation of a line of demarcation, and, this succeeding, a kind of amputation takes place, followed, after long suffering, by recovery. The event is denoted by the establishment of ulcerative action at the limits of the dead parts, immediately above which the surface exhibits a dusky, erysipelatous blush, very different from what usually occurs in ordinary gangrene. The sloughing process is generally attended with severe pain and the most offensive smell.

The *cause* of senile mortification was not, until recently, at all understood. Mr. Cowper, the anatomist, had, it is true, advanced the idea, now become general, that it was owing to ossification of the arteries, but his researches had not been conducted upon a sufficiently extensive scale to justify the positive conclusions which modern observation has so fully established. The result of my own dissections is very decidedly in favor of this view. Ossification of the arteries, however, is merely a predisposing, and not the immediate cause of the lesion, which consists in the formation of fibrinous clots closing up the calibre of the arteries, and thus mechanically intercepting the passage of the blood. I have ascertained that the principal obstruction occasionally exists at a considerable distance from the seat of the disease. Thus, I have found the occlusion limited altogether to the femoral artery, the popliteal, or the commencement of the tibial and fibular. In most cases, however, it affects also the smaller branches. The concretions generally exist in various degrees of development, from recent coagulation of the blood to complete organization; hence, while some can be easily detached, others are firmly adherent to the sides of the vessels.

What the immediate cause of these clot formations is has not been determined. It has been alleged that it is owing to the interception of the fibrin of the blood by the roughened walls of the arteries consequent upon their calcification; but my own view is that it is due to an effusion of plastic matter, the result of chronic inflammation of the serous membrane, thereby favoring the adhesion of the blood and its conversion into clots.

A very remarkable form of chronic gangrene is sometimes produced by the inordinate use of *ergot* or *spurred rye*, the secale cornutum of botanists. The affection, which has occasionally prevailed endemically, has hitherto been observed chiefly among the inhabitants of France, Germany, and Switzerland, in certain districts of which rye bread forms a principal article of diet. When the seasons are very wet an unusual quantity of ergot is generated, and this entering largely into the composition of the flour has the effect, when used for any length of time, of giving rise to mortification in the remote parts of the body. The attention of the profession was first directed to the subject in a prominent manner in 1676, by Mons. Dodard, a French physician, and since then it has been frequently noticed by other writers. For a long time doubts were entertained respecting the power of ergot to produce this effect, and in order to solve these Mons. Tessier, of Paris, was commissioned, many years ago, by the Royal Academy of Medicine to investigate the matter experimentally. For this purpose he selected various animals, especially pigs, ducks, and turkeys, which he fed exclusively upon ergot; he found that most of them died between the tenth and twenty-fourth day, and that distinct marks of mortification existed in the bodies of all, both externally and internally. Since the poisonous effects of this substance have become so well understood the disease has almost entirely disappeared, and in this country I am not aware that it has ever been noticed in the human subject. It is said, however, to have prevailed extensively among the horned cattle of Chester County, in this State, in 1819, and in the following year in Orange County, New York, in consequence, as was supposed, of the free use of the green grass, the *poa viridis*, the seeds of which were affected with ergot.

The manner in which ergot acts in producing this disastrous effect has not been explained. It is very singular that its virulence should explode upon those parts of the body which are most remote from the heart, as the feet and legs, and the corresponding portions of the upper extremities, along with the nose, chin, and ears. I am myself inclined to believe that the primary impression of the poison is upon the blood, rendering it abnormally stimulant and plastic; and the secondary upon the inner coat of the arteries, which, becoming inflamed, thereby intercepts the liquid, and thus leads to the formation of fibrinous clots. In a word, there is reason to believe that mechanical obstruction of the vessels is the direct and immediate cause of the gangrene, and if this idea be correct, we cannot fail to discover the closest analogy between this form of the disease and senile mortification described in a previous page. It is much to be regretted that Dodard, Noel, Bossau, Gassoud, and others, who have left such admirable descriptions of the external characters of this strange affection, should not have given us any account of its pathological anatomy.

Mortification from ergotism has been observed at all periods of life; it is usually preceded by discoloration, pain, and burning heat, which, subsiding in the course of four or five days, leave the parts cold, dry, hard, insensible, of a uniform black color, and free from fetor. It generally begins in the toes, whence it gradually extends over the foot and leg, until, in some cases, which, however, are rare, it reaches as high up as the hip. Occasionally it appears simultaneously both in the lower and upper extremities, as well as in the nose and ears. Sometimes the disease is accompanied by considerable swelling and by the most excruciating pain, which allows the patient no rest day or night. The constitutional symptoms vary, being at one time very slight, at another excessive; in general, however, the patient is tormented with fever, thirst, restlessness, and high delirium. Under favorable circumstances ulcerative action is set up, and this, gradually progressing, at length eventuates in spontaneous amputation of the sphacelated structures.

Anomalous cases of chronic mortification occasionally occur, so obscure in their character as to render it impossible to refer them to any particular division of the disease. To this variety belongs the extraordinary instance, published a few years ago, in the Philadelphia Medical Examiner, by Dr. Bernard Henry, of this city, of a female, aged forty-two, who suffered from gangrene of all the extremities, from the effects of which she finally died. She was the mother of nine children, of intemperate habits, and formerly affected with syphilis. The malady was preceded by stinging and burning pains in the hands and feet, which, together with the top of the nose and the skin of the knees, were gradually transformed into black, dry, and shrivelled bodies, the gangrene finally extending beyond the middle of the arms and legs. The only lesion revealed on dissection was some contraction of the left auriculo-ventricular orifice, which seemed to have obstructed the flow of blood into the aorta. The arteries were free from ossification.

This disease sometimes appears at a very early age. An instance, the particulars of which were related to me by the late Dr. Leonard, of New Albany, Indiana, occurred, some years ago, in the vicinity of that city, in a little girl only six years old, who, while seemingly in tolerably good health, was suddenly seized with excessive prostration, accompanied with delirium, unconsciousness, and great depression of the temperature of the whole body. In a short time the left lower extremity became livid, and by next morning the foot was found to be dead as high up as the ankle, the surface being black, dry, cold, and insensible. At the end of about a week a line of demarcation began to appear, and amputation being performed below the knee, the case resulted in a good recovery. It is worthy of remark that the little patient experienced at no time any considerable pain or constitutional disturbance.

Treatment.—Much diversity still exists among authors respecting the proper method of treatment in chronic mortification; some favoring stimulating measures, while others are the warm and avowed advocates of depletion, just as if it were possible in a disease which exhibits such a protean character to lay down any one plan that shall be applicable to all cases. When a writer recommends an exclusive system of treatment, and especially when he inculcates the adoption of that treatment with extraordinary enthusiasm, tinctured, perhaps, with a sense of bitterness which neither the subject nor the occasion demands, his views may well be received with some degree of allowance; and to no surgical topic is this remark more justly applicable than to that under consideration. If the reader will take the trouble to peruse the literature of the profession upon this subject from the time of Mr. Pott down to our own, he cannot fail to be struck with the truth of this remark, nor fail to lament the uncertainty of medical doctrine and practice. How are we to reconcile such discrepancies? By supposing that different practitioners have had totally different and opposite classes of cases, or that the disease varies in different countries and at different seasons, being now attended with high excitement, and now with great depression? Such occurrences are possible, but not probable, unless we conclude that there has been an extraordinary concurrence of events, or that the views of these opposite partisans are founded upon the most limited personal experience. A more plausible conjecture is that these notions are incorrect, from having been deduced from an insufficient number of facts, or that they are the offspring of preconceived hypotheses. However this may be, it is certain that no one method of treatment is applicable to chronic gangrene, although, as a general rule, the stimulant will be found to be the most reliable. I have seen cases where, from the robust state of the individual, and the character of the pulse, no doubt could be entertained about the propriety of the employment, at least, to a moderate extent, of antiphlogistic measures, where, indeed, even the lancet and antimony were admissible; but I am quite sure that such instances are comparatively few, and that, even in them, too much caution cannot be used in their adoption. Nine patients out of ten would be injured by this course. The symptoms are generally of a typhoid character from the very beginning of the malady, and not only so, but the disease nearly always occurs in old, worn-out subjects, or in persons who have long labored under depression of the nervous, vascular, and muscular powers, and who are therefore ill-prepared to undergo such a plan of treatment with impunity. Tonics and stimulants, judiciously administered, and aided by appropriate local measures, constitute the proper means in such cases. Sometimes a "masterly inactivity" is more effective than anything else, the surgeon doing little more than watching the case, and attending to his patient's diet, bowels, and secretions. But, in general, it will be found that a supporting plan of treatment is absolutely necessary, to prevent the system from falling into a hopeless state of exhaustion. Quinine, carbonate of ammonia, and the tincture of the chloride of iron, with wine-whey, or milk punch, and opium, are the articles most to be relied upon, and they should be given in such doses as shall be calculated to meet the exigencies of each particular case.

Locally the best remedies are the dilute tincture of iodine, brushed very thoroughly twice a day over the whole of the affected part, and the use of the bandage, applied with moderate force, and kept constantly wet with a strong solution of opium and acetate of lead, Goulard's extract, or hydrochlorate of ammonia. Leeches are usually objectionable, as their bites are sometimes provocative of gangrene, and the same remark is applicable to punctures and incisions. By these means the inflammation of the obstructed vessels may now and then be promptly arrested, and the further extension of the mortification prevented.

When the sloughing process has commenced, the treatment must be conducted upon the same general principles as in the acute form of the malady, only that the local applications should, if possible, be still more mild and soothing. The most eligible remedies are, according to my experience, the nitric acid lotion, in the proportion of from two to six drops to the ounce of mucilage of gum arabic, or the opiate cerate, for the ulcerated surface, and cloths constantly wet with a solution of chloride of lime for the dead, especially if there be much fetor. As the parts become detached they may be removed with the scissors, but this must be done with the greatest possible gentleness, as the slightest injury inflicted upon the living tissues is sure to be productive of mischief.

In regard to the question of amputation, it is extremely difficult to give any satisfactory statement. My belief, founded upon considerable experience, is that we ought scrupulously to follow the practice long ago laid down by surgeons not to interfere until there is a well-marked line of demarcation; and, indeed, not even then unless it is perfectly evident that there is sufficient strength of the system to bear the shock of the operation. I have, however, seen several cases where amputation was succeeded by the most happy results before nature had made any attempt to cast off the slough, and that too under circumstances apparently not at all promising as it respected the powers of the constitution. Whenever surgical interference is deemed advisable no means should be spared to support the patient with tonics and stimulants, as upon their judicious use the chances of his recovery will, in great degree, depend. When the operation is performed prematurely, or before the system has sufficiently recovered from the exhausted condition consequent upon the gangrenous action, the disease will generally reappear within a few days after upon the stump, or death will follow from sheer prostration.

In regard to chronic mortification from the use of ergot, we have no positive knowledge to guide us in our treatment. There is no remedy, so far as is at present known, the employment of which exerts the slightest counteracting influence upon the deleterious effects of this substance upon the system. Hence the only proper plan of procedure is to treat all such cases upon the general principles just laid down in respect to the management of the ordinary form of chronic gangrene.

SECT. VII.—HOSPITAL GANGRENE.

Under this name may be described a variety of mortification, or of mortification and ulceration, which often commits great ravages among the wounded in crowded hospitals, in camps and on board of vessels of war. The disease appears to be much more common in Europe and in the East than in this country, where, judging from the silence of the profession respecting it, it is exceedingly infrequent, a case being rarely met with even in our larger eleemosynary institutions, while in private practice it is almost unheard of. I place this affection between mortification and ulceration, as it evidently, in many cases, if not in all, strongly partakes of the nature of both.

Although it is extremely probable that hospital gangrene has existed from time immemorial, yet no distinct and satisfactory account of it appeared until 1783, when an admirable description of it was published in the posthumous works of Pouteau, of Lyons, who had himself suffered from a severe attack of it while resident pupil of the Hôtel Dieu of that city. Soon afterwards attention was directed to it by Dussassoy, whose treatise was rapidly followed by the tracts of Moreau, Burdin, Gillespie, Leslie, Blackadder, Brauer, and Boggie, to whose joint labors we are mainly indebted for our present knowledge of this curious disease.

Various names, more or less expressive of the nature of this disease, have been employed to designate it by different authors. Thus, by Pouteau and some of the earlier writers upon the subject, it was denominated hospital gangrene, evidently in reference to the frequency of its occurrence in this class of public institutions, of which it was at one time the great scourge, both in military and civil practice, particularly the former. Subsequently it was described under the appellations of contagious gangrene, gangrenous phagedena, putrid degeneration, malignant sloughing, or putrid ulcer, camp gangrene, and humid hospital gangrene.

Sporadic cases of this variety of gangrene, more or less severe, are occasionally met with in all large hospitals and other places crowded with sick and wounded, but we no longer hear of that frightful devastation which used to characterize its existence in former times. This happy change is no doubt due to the great attention which the modern practitioner bestows upon ventilation and cleanliness, and the prompt segregation of his patients on the appearance of the malady. According to Mr. Macleod, hospital gangrene was not at all common among the English during the late war in the Crimea; it prevailed during the first winter in a mild form at Scutari, but it never became either general or severe, although the barrack hospital of that city was, during the early occupation of the troops, in a very filthy and uncomfortable condition. Whenever any cases broke out, the patients were at once isolated, and sent into wards especially set apart for the treatment of the disease. The French, on the other hand, suffered most severely, owing, as was supposed, to the injury which they sustained during their removal immediately after being wounded to the hospitals on the Bosphorus, and to the manner in which they were crowded together in the wards of those institutions.

Formerly hospital gangrene often prevailed as an *endemic*, attacking almost every one that was brought within its baneful influence, and thus causing the most horrible mortality. In the Hôtel Dieu, at Lyons, in the time of Pouteau, several frightful outbreaks of this sort appeared, and such were their ravages that this distinguished surgeon was induced to ask the question, whether hospitals were not an evil instead of a blessing. In 1780, the disease prevailed extensively among the inmates of the naval hospital at New York, some of whom had been sent thither from the American squadron, then in port on account of stress of weather, others from the West Indies. Upwards of two hundred cases occurred, and of these many died; quite a number from the recurrence of gangrene upon the stump after they had suffered amputation. In 1781, the malady committed terrible ravages at the naval hospital on Pigeon Island, St. Lucia. In 1800, it prevailed extensively on board the Prince of Wales, on her homeward passage from Martinique to England; the suffering is described as having been excessive, and it is stated that every little scratch or injury, in whatever manner inflicted, speedily degenerated into a bad gangrenous ulcer. A short time before this, the disease existed, in a very severe form, at the Cape of Good Hope. At the hospital at Bilbao, after the battle of Vittoria, the mortality from this source was excessive. In the Parisian hospitals, the disease has prevailed, off and on, for many years, often sadly interfering with the results of surgical accidents and operations. In 1847, it appeared in some of the London hospitals, and nearly at the same time in some of those at Edinburgh; in both cities, however, in a mild and transient manner.

I have adduced these references with a view of showing the occasional epidemic tendency of this disease, and the consequent absolute importance of avoiding the huddling and crowding together indiscriminately of the sick and wounded in large hospitals, camps, and other places, often selected with little judgment, for the accommodation of the poor. There can be no doubt whatever that much, if not the whole, of the immunity enjoyed by the hospitals, infirmaries, and almshouses of this country is due to the vigilance that is exercised in the sequestration of their inmates and the great attention that is paid to the cleanliness and ventilation of these establishments; circumstances which can never fail to exercise a powerful prophylactic influence upon this and other diseases whose origin and propagation are so closely connected with a vitiated state of the atmosphere and a disordered condition of the blood.

Hospital gangrene shows itself in one of two ways: either as an original affection, upon an unbroken surface, or in connection with an open wound, ulcer, or abrasion; more frequently in the latter than in the former. When the tendency to the disease is very strong, the slightest scratch, or the most trivial sore or wound may become the means of propagating it, and of producing the most frightful ravages. Several instances have been recorded of the most horrible sloughing occasioned by the accidental inoculation of the bite of the mosquito. When the disease prevails endemically, or even when there is merely some tendency to its outbreak, no operation, however insignificant, can be performed with any certainty that it will not be followed by hospital gangrene. The stripes inflicted in flogging soldiers have frequently been known to become the seat of the disease in its very worst forms. Boils, abscesses, sinuses, fistules, and cicatrices generally, under such circumstances, share a similar fate. It has been noticed, what is certainly very singular, that, when hospital gangrene exists as an endemic, it manifests but little disposition to seize upon ulcers of a specific nature, as chancres, syphilitic buboes, and cancerous sores. In its sporadic form, on the contrary, these are the parts which seem to be particularly liable to suffer, the disease often attacking them, apparently, in preference to simple ulcers.

The distinction, which has been made by some authorities, of this disease into sloughing and phagedenic, seems to me to be improper, since it is evident that the two affections are merely different grades of the same disorder, the one destroying the tissues in large masses, the other on a small scale, the action by which this is done being strictly identical in both cases. A much more important division is that into idiopathic and traumatic, the origin of the former depending upon constitutional causes, that of the latter upon external injury.

If we inquire into the *causes* of this variety of gangrene, we shall find little to reward our labor. While some regard it as a strictly local affection, others are disposed to consider it as having a constitutional origin; and in this opinion I am strongly inclined to concur, from a careful study of the history of the disease, both from what I have seen of it myself, and from the accounts given of it by different writers. Possessing many features in common with erysipelas, it is highly probable that, like that disease, it owes its origin to a species of blood-poisoning, depending upon a foul, infected atmosphere, operating upon a depraved and enfeebled constitution. It is very certain that the strong and robust are much less liable to suffer from it than those of an opposite state of the system, or who have become exhausted by intemperance, disease, exposure, or want of proper food; and it is often easy to determine, beforehand, when a great many persons are crowded together in the wards of an infected hospital, which will be likely to be attacked and which to escape, simply from the differences in their appearances. Whether the subjects of hospital gangrene are capable of generating a poison which, in its turn, can impart the disease to others, by its operation upon the system, is a point for whose solution we possess no reliable data; but that this is the case, seems to be extremely probable. However this may be, the fact that the malady may be communicated by actual contact of the secretions of a gangrenous sore with a sore of a healthy character, seems to be well established; at all events, the theory is constantly acted upon in institutions where the disease is prevalent, in the care which is taken to prevent sponges and other articles used in cleansing and dressing affected persons, from being employed upon healthy ones. A very striking circumstance, bearing strongly upon the question of the existence of a distinct poison elaborated during the progress of this malady, has been recorded by Sir George Ballingall, in his Outlines of Military Surgery. Referring to this disease as it prevailed in a regimental hospital at Feversham, in 1806, he states that, after the endemic had been going on for some time, it was discovered that all the ulcers in the establishment had been washed with one sponge. A different mode of cleansing the sores was immediately adopted, and the consequence was that not a single case of the disease appeared afterwards. When to this circumstance is added the result of the experiment of Ollivier, who produced the disease in his own person, by inserting matter, taken from an ulcer of the very worst description, into the arm just below the attachment of the deltoid muscle, it is impossible to withhold our belief in the contagious property of traumatic hospital gangrene. The case of Blackadder, who suffered severely from a puncture accidentally inflicted upon one of his fingers in dissecting the stump of a man dead of this affection, is equally strong and convincing.

A scorbutic state of the system, severe shock, loss of blood, and, in short, all depressing influences whatever, probably act as so many predisposing causes of this disease, by lowering the powers of the heart and nervous system, and thereby favoring the operation of the septic poison, if such a poison really exist. Protracted courses of mercury, or exposure to wet and cold during salivation, have often been observed to be followed by the disease during its endemic prevalence. In private as well as in hospital practice, it is particularly liable to be induced in young, unhealthy, scrofulous persons, affected with syphilitic ulcers, and weakened by all kinds of privation, especially the effects of cold, and the excessive use of ardent spirits. In the army and naval service of Europe, it formerly often supervened upon severe and exhausting attacks of dysentery, scurvy, and typhoid fever.

The time that the poison of hospital gangrene lies *latent* in the system has not been determined. It probably varies in different persons and in different cases, depending upon the previous state of the general health, and the peculiar mode of the infection. In most cases it is short, not exceeding thirty-six or forty-eight hours before it shows its specific effect. When the infection is indirect, a longer time is probably required for the development of the disease than when it is direct, or effected by actual contact of the secretions.

The disease occurs at all periods of life, and the only reason, probably, why children do not suffer more frequently, is that they are so seldom subjected to the influence of its exciting causes. Both sexes are obnoxious to it; but, for the reason just mentioned, men suffer much oftener than women. No season of the year is exempt from its attacks, but it is most common, as well as most virulent, in hot weather.

The *symptoms* which characterize this affection are partly of a local, partly of a constitutional nature, the order of their priority being not always easily determined. When it supervenes upon an ulcer or abrasion, the appearance of the pre-existing affection undergoes at once a series of the most important changes, completely modifying its whole aspect. The discharge is sensibly diminished, or, perhaps, entirely dried up; the granulations, if any exist, assume a dark, foul appearance, and are rapidly destroyed; a large quantity of aplastic lymph, of a dirty grayish color, soon covers the bottom of the sore, the edges of which at the same time become jagged and everted; the adjacent parts are of a deep purple or livid hue, and the seat of numerous vesicles, filled with a sanious or bloody serum; the pain is constant and excessive, being sharp, biting, or stinging; the affected structures exhale a horrible odor; and swelling is both great and threatening. Sloughing now takes place, skin, cellular tissue, fascia, and muscle often dropping off in large, livid, putrescent masses, thoroughly impregnated with the most horribly offensive secretions. In the more severe forms of the lesion, the ravages are not limited to the soft parts, but often extend to the bones and even to the joints; the affection, perhaps, rapidly travelling up a limb until it is completely destroyed, the patient literally dying, as it were, by inches. Long before this crisis has been attained, indeed, generally at an early period, glandular swellings are observed in the groin or axilla, possessing many of the features of pestilential buboes; they usually involve a number of ganglions, and are always exquisitely tender and painful, thus greatly aggravating the local and constitutional distress. When suppuration occurs, which, however, is not invariably the case, the discharge is generally abundant and highly fetid, and the resulting ulcer speedily exhibits all the characteristics of the parent sore.

When the disease appears on an unbroken surface, which, however, it rarely does, its advent is announced by the formation of one or more little vesicles, or blebs, filled with ichorous fluid, and surrounded by a reddish areola; both gradually extending, the former soon bursts, and thus reveals a dirty, foul slough, which, dropping off, exposes a filthy looking, excavated cavity, incrusted with a thick layer of adherent, grayish, unorganizable lymph. The parts feel hot and stinging; there is great swelling, with livid discoloration, of the adjacent surface, and a tendency to rapid extension and destruction, the different tissues dying either together or successively, in the same manner as when the disease is ingrafted upon an ulcer or open sore.

The constitutional symptoms of hospital gangrene are generally well marked, their severity being usually in proportion to the violence of the local disturbance. If the patient, prior to the attack, was tolerably strong and robust, they will probably be of a strictly inflammatory nature, but in any event they will soon lose this type, and assume the asthenic form, which will become more and more distinct as the disease pursues its downward tendency. The pulse will be found to be unusually frequent, quick, and irritable; the mind is peevish, fretful, and desponding; the tongue is dry, and covered with a brownish fur; the strength is much impaired; and the pain is so excessive that the patient is completely deprived both of appetite and sleep. Delirium often sets in at an early period, forming one of the most prominent symptoms.

The *diagnosis* of hospital gangrene is generally not difficult, for there are few diseases with which it can be confounded. Almost the only affection, indeed, for which it is in danger of being mistaken is scurvy, but a little attention will usually serve to render the distinction between them very evident. The scorbutic ulcer, as it has been named by Lynd and other writers, is remarkable for its fungous, livid, bloody, and fetid character; the granulations are of enormous size, very soft and spongy, growing with great rapidity, only in persons of a comparatively robust constitution, and in the earlier stages of the disease; but even then it should be practised with much caution, lest it should lead to fatal exhaustion, or so far damage the system as to prevent it from shaking off, without great difficulty, the morbific influence. The disease, it must be recollected, has an asthenic tendency, often from the very start, especially when it is of an endemic character; and hence any measures calculated to favor this tendency must necessarily exercise a pernicious influence.

Purging and attention to the diet and secretions constitute important elements in the treatment, and must on no account be neglected. A good dose of calomel and rhubarb, or of equal parts of blue mass, jalap, and compound extract of colocynth, given so as to induce two or three large, consistent, alvine evacuations, will often be more beneficial in arresting the morbid action than almost everything else of which we have any knowledge. Subsequently the bowels should be constantly maintained in a soluble condition, without establishing any decided drain upon them, and the utmost care should be taken to restore the secretions, which are always so much disordered in hospital gangrene. Mercury, as a salivant, is to be avoided as a poison.

When the system begins to flag, whether from the overwhelming influence of the attack, or from the neglect of the proper treatment, prompt recourse must be had to quinine, iron, wine, brandy, and nutritious broths. The best preparation of iron is the tincture of the chloride, given in doses of from fifteen to twenty-five drops, every three or four hours, in some mucilaginous fluid. Quinine is often extremely serviceable, and there are few cases, when this stage has been attained, which will not be immensely benefited by brandy, or some other form of alcohol, either alone or combined with milk.

But the great constitutional remedy in hospital gangrene is opium, either in substance, or in the form of the salts of morphia. It should be given in large doses, generally not less than from four to six grains, every four, six, or eight hours, in union with a diaphoretic, as ipecacuanha, tartar emetic, or the neutral mixture. When we reflect upon the excessive pain, irritability, and sleeplessness which so generally attend the severer grades of this disease, it is impossible to place too high an estimate upon the value of anodynes as means not only of insuring comfort to the patient, but of arresting the morbid action.

The diet, especially in the latter stages of the disease, should be highly nutritious, and given in as concentrated a form as possible. The patient's apartment should be consequently ventilated, the bed and body clothes should be daily changed, and the surface should be frequently sponged with tepid salt water, or weak alkaline solutions. Free use should be made of the chlorides, sprinkled about the room. If the disease manifests an endemic tendency, as when it breaks out on board ship, or in the crowded wards of a hospital, the patients should be promptly sequestered, and the apartments whitewashed and thoroughly cleansed.

When the disease is obviously connected with a scorbutic state of the system, the best internal remedies will be potassa, in union with lemon-juice, potatoes, water cresses, oranges, and other fresh fruits and vegetables.

The *local treatment* should be of the most gentle and soothing character. Any vesicles that may exist should be promptly opened, and the whole surface pencilled over with a weak solution of iodine, followed by the warm or cold water-dressing, containing a large supply of acetate of lead and opium, a cloth dipped in the solution being kept constantly upon the part. If an eschar has formed, the adjacent structures should be freely rubbed with the solid nitrate of silver, and as soon as the slough has dropped off, the bottom of the sore should be thoroughly touched with a solution of acid nitrate of mer-

We have an illustration of this occurrence both in the skin and in the mucous membranes. Common ulceration of the skin is by far most frequent in the legs and feet, whether because these parts are in a state of habitual congestion, or because they are more exposed to fatigue and accident, is not determined; but that this is the fact daily observation abundantly attests. Ulceration is extremely rare in the œsophagus, but quite common in the pharynx, tonsils, tongue, cheeks, and lips. The same statement is true of ulceration of the stomach and small intestine as compared with ulceration of the colon and rectum. In the genito-urinary division of the mucous system the same law obtains. Thus, the disease is extremely infrequent in the urethra and bladder of the female, but common enough in the vulva, vagina, and uterus. The male, on the contrary, rarely suffers in any portion of the genito-urinary apparatus.

The terms common and specific, as applied to this disease, are sufficiently significant. By the former is meant an ulceration that is liable to occur in all persons, as well as in all parts of the body; one which is the result of ordinary inflammation. The word specific, on the other hand, is employed to denote an ulceration which is the product of some specific cause, which runs a peculiar course, and which, in its progress, furnishes a specific secretion, capable, by inoculation, of producing a similar action. To this category belong syphilitic ulceration and the ulceration which follows vaccination and smallpox. The ulceration which attends carcinoma is also specific, but the matter it yields is not, so far as we know, capable of propagating a similar disease.

Ulceration varies in its progress, being sometimes very rapid, at other times very tardy. The circumstances which determine this result are not always appreciable, but, in general, they may be considered as depending upon the nature of the exciting cause, the amount of the attending inflammation, and, above all, upon the state of the system. When the action is very rapid, an extent of surface may be destroyed in a few days which it will perhaps require several months to repair. The process often goes on simultaneously at several points in the same organ or tissue, and not unfrequently in structures of an entirely opposite character.

The *causes* of ulceration are such as produce inflammation, which, as has been already stated, always accompanies the process. They may be very properly divided into predisposing and exciting. The former comprise an impoverished state of the blood, however induced, and, in short, whatever has a tendency to impair the powers of the system. Experiments, performed long ago, by Magendie and others, have established the fact that the protracted and exclusive use of starch, sugar, and other non-azotized articles of food, will produce ulceration of the cornea; and it is well known that the poorer classes of people, who are ill fed and sometimes almost starved, are peculiarly subject to this disease in the skin and mucous membranes. Ulceration of a severe nature often follows upon various kinds of fever, especially typhoid, scarlet, and morbillous, from the exhausting influence which they exert upon the solids and fluids.

Of the exciting causes of ulceration, nothing need be said, except that they may be common or specific, the latter being such as act primarily upon a particular part, as the head of the penis in chancre, or secondarily, in the same disease, upon the constitution, in consequence of the absorption of the specific poison. Tubercular, scirrhous, encephaloid, and melanotic matter, having undergone a process of softening, always creates ulceration by its pressure upon the adjacent tissues, thereby favoring its elimination from the part and system.

The inflammation which precedes and accompanies ulceration varies much in its degree, as well as in its character. When acute, it is usually marked in the spongy structure of the bones, in the movable joints, and in malignant growths, it often continues for an almost indefinite period, being better at one time and worse at another. When it is about to cease, the accompanying inflammation gradually subsides, the discharges disappear, and, plastic matter being poured out, granulations are formed, by which the breach is finally closed up, the process of cicatrization generally, if not always, proceeding from the circumference towards the centre.

In the *treatment* of ulceration, the great and leading indication is to combat the concomitant inflammation, and thus place the part in a condition for the efficient development of granulations, as it is through their agency that the lost substance is to be repaired. For this purpose the ordinary antiphlogistic appliances are to be put in requisition and continued until the morbid action has been completely arrested, as will be denoted by the subsidence of the pain, heat, swelling, and redness by which it is usually characterized. When granulations begin to form, none but the most mild and soothing measures must be employed, and the sore carefully watched to keep it in a healthy condition until it is perfectly cicatrized. In specific disease, as chancre and malignant pustule, the most efficient treatment, provided the case can be seen in time, before the matter has been absorbed into the system, is to cut out the part or destroy it with the actual cautery, Vienna paste, or acid nitrate of mercury.

ULCERS.

An ulcer is a breach in the continuity of a surface, organ, or tissue, attended with inflammation, and a discharge of pus, ichor, or sanies. The disease is of frequent occurrence, being met with at all periods of life, in both sexes, and in all classes of persons, and is often a source of great suffering to the patient, as well as of immense trouble and vexation to the surgeon. Its very name carries with it an idea of loathsomeness, and it may well be imagined how much this feeling is increased when, as so often happens, the sore is the seat of foul and offensive discharges, rendering the patient disagreeable both to himself and to all around him.

It may confidently be asserted that there is not, in all surgery, a class of maladies whose pathology and treatment are less thoroughly understood, by the profession generally, than those of ulcers. It is amazing to find what an immense amount of confusion still exists upon the subject, at the present day, among many of the best and most experienced authors. In examining the various treatises on surgery, in the principal languages of Europe, the inquirer after truth has but little cause to congratulate himself upon the progress that has been effected in this department of the healing art. He looks almost in vain for any positive additions to his stock of knowledge since the latter part of the last century, when Mr. Benjamin Bell published his Treatise on the Theory and Management of Ulcers. The minute divisions and subdivisions, the refinements and absurdities, respecting the nature of these lesions, are, with little variation, substantially reproduced by most of the practical writers of the present day. In studying the literature upon the subject, one is almost forced to the conclusion that, while every other branch of surgery has experienced the benign influence of progress, this one alone has remained unimproved and uncared-for. I am, indeed, ready to admit that the nosography of ulcers is much more perfect now than it was in former times; but who can read their classification, as it appears in most of our modern treatises, and not be struck with its many absurdities and inconsistencies? The catalogue is absolutely appalling, and it must be apparent to the most superficial observer that it comprehends, under different names, diseases which are

There are two genera of ulcers, the common and the specific, just as there are two genera of inflammations. Common ulcers are such as are produced by ordinary causes, as common inflammations, abrasions, and wounds; specific ulcers, on the contrary, owe their origin to the operation of some peculiar virus, as the poison of syphilis, smallpox, glanders, malignant pustule, scirrhus, encephaloid, tubercle, or melanosis. Although the ensuing remarks are more particularly intended to illustrate the various forms of common ulcers, yet they are also, in some degree, applicable to the specific, which, however, will receive special attention in their proper place.

1. ACUTE ULCERS.

The acute ulcer is distinguished by the rapidity of its progress, and the severity of its symptoms, which are those very much of ordinary acute inflammation. The sore usually begins at a small point of skin, or skin and cellular tissue, from which it speedily spreads in different directions until it often covers a large extent of surface. In its form it is generally somewhat oval or circular, but it is frequently very irregular, and instances are met with in which it is of a serpiginous, creeping, or angular shape. When the ulcerative action commences simultaneously at several spots, as occasionally happens, the sore may have a peculiar sieve-like, or worm-eaten appearance, similar to that of the cover of an old book, or the bark of a tree. Its surface is red and angry-looking, either uniformly, or red at one point, and white at another, owing to a deposit of aplastic matter, which occasionally overspreads it completely. When the action is unusually severe the bottom of the ulcer generally exhibits a foul, greenish, brownish, or blackish appearance, and if, under such circumstances, any plasma is poured out, it is immediately spoiled or washed away by the discharges, which are always profuse, thin, sero-sanguinolent, and irritating, possessing none of the properties of laudable pus, such as is furnished by a granulating wound. In regard to the edges of this class of ulcer, they present the greatest possible variety; in general, however, they are thin, rather sharp, and somewhat undermined, or undermined at one place, straight at another, and perhaps everted at a third: in some cases they are very steep and ragged, notched or serrated. Extending from the sore in different directions are occasionally small sinuses or fistulous passages, which thus greatly complicate its character and protract the cure. The parts immediately around the ulcer exhibit all the phenomena of high inflammation, being of a deep red or purple color, preternaturally hot, painful, and more or less œdematous from sero-plastic effusions, and consequently pitting under pressure. The latter symptom is hardly ever entirely absent in any case of acute ulcer, and is therefore of great diagnostic value. The œdema often extends over a considerable surface, but is always most conspicuous in the immediate vicinity of the sore. The same remark is applicable to the other inflammatory phenomena.

The pain of the acute ulcer is frequently a prominent and absorbing symptom; it varies not only in degree but likewise in character, being at one time throbbing, or pulsatile, at another sharp or pricking, at another dull, heavy, and gnawing, as if insects were feeding upon the part. Its violence is often altogether disproportionate to the extent of the morbid action. I have seen cases where, although the ulcer was scarcely as large as a twenty-five cent piece, it was so excruciating as to deprive the patient of sleep for days and nights together, and bring on rapid emaciation and hectic irritation. It may be limited to the sore, but in general it is felt over the whole of the inflamed surface, and is usually worst at night and in damp states of the atmosphere. Posture also commonly aggravates it, being generally more severe when the part hangs down than when it is elevated, although I have occasionally found the reverse to be true, even when the sore was quite large.

Along with these phenomena there is generally considerable constitutional derangement, manifesting itself, commonly not so much in febrile commotion, as in an irritable state of the system, and disorder of the digestive organs. The patient feels unwell rather than sick; his head troubles him; his appetite is vitiated, or temporarily arrested; the tongue is coated, and there is a bad taste in the mouth, especially in the morning; the bowels are inclined to be constipated; and the urine is scanty and high-colored. When the ulcerative action is rapid and extensive, there is frequently more or less fever, with thirst, restlessness, loss of sleep, and excitement of the pulse. Disorder of the secretions is generally a prominent symptom in these cases, especially of the liver, the uterus, and mucous follicles.

An impoverished state of the blood, however induced, habitual intemperance, excessive indulgence at table, mental anxiety, exposure to cold, and the various eruptive diseases may be enumerated as so many predisposing causes of the acute ulcer. Nervous, irritable, and plethoric persons, especially old dram drinkers, are its most frequent subjects. Both sexes are liable to it, but men suffer much more frequently than women. The malady is rarely met with in the higher circles of society, and it is also very uncommon in children.

The acute ulcer may be a primary affection, or an ulcer, after having been for some time in a dormant condition, may suddenly assume the acute character, either in consequence of local or constitutional causes, or of both combined; that is, the part becomes more or less severely inflamed, and manifests a tendency to extend its ravages. However this may be, the disease often spreads with great rapidity, eating away everything with which it comes in contact—skin, cellular tissue, fibrous membrane, muscle, and sometimes even bone—and often laying waste in a few days an extent of surface which it may take months, aided by the best skill, to repair. When this is the case, the action may be said to be truly phagedenic, or to consist in rapid mortification of the molecular structure of the suffering part, which is hot, œdematous, fiery red, exquisitely painful, and bathed with profuse, fetid discharges. Constitutional disturbance is great, and the tendency is usually decidedly typhoid, especially if the subject of the disease has been worn out by intemperance and other causes of depression. This form of ulcer is very prone to occur upon new and imperfectly organized skin, where it often commits the most terrible ravages, which, for a time, hardly anything can successfully resist.

Treatment.—The treatment of the acute ulcer must be conducted upon strictly antiphlogistic principles, modified, of course, by the peculiar exigencies of each particular case. When the symptoms are urgent, as denoted by the severity of the local and constitutional disorder, the indication obviously is to take blood from the arm, provided the patient is at all plethoric, or, this not being permissible, at all events to open his bowels freely with an active cathartic, containing from five to ten grains of calomel, and followed up, if necessary, in six or eight hours, by infusion of senna and sulphate of magnesia; recourse is then had to the antimonial and saline mixture, to subdue vascular action; and opium is administered in large doses to allay pain and induce sleep. The diet must be mild, and not too nutritious, and the patient must observe the most perfect rest in the recumbent posture. Active purgation will be found of the greatest value in this form of ulcer; in fact, it is difficult to imagine a case in which it could be entirely dispensed with. To render it promptly effective, however, I have long been in the habit of combining with it a certain quantity of mercury, either in the form of calomel, or blue mass, with a view of making a strong and rapid impression upon the secretions, which, as before stated, are usually notably deranged, and which thus keep up a spreading tendency in the disease. Of the beneficial effects of anodynes in arresting acute ulceration no one can form any just conception, who has not witnessed them. That they exert any direct influence upon the part itself cannot be supposed; but that they produce a most salutary impression by tranquillizing the heart's action, and allaying nervous irritability, which is generally so prominent a symptom in this affection, is indisputable; hence the remedy should always be given in large and sustained doses from the very commencement of the malady.

It is not to be inferred from the remarks now made, that active depletion is suited to all cases of this disease; on the contrary, we are often obliged to use tonics and stimulants at the very beginning of the treatment, and to continue their exhibition until we have succeeded in building up the system, so as to enable it to oppose a successful barrier to the encroachment of the morbid action. The state of the pulse, skin, digestive organs, and muscular system will generally serve as a correct guide to the kind of treatment best adapted to meet the exigencies of this class of cases. Quinine and milk punch, with opium, or the salts of morphia, will usually constitute the most reliable means.

The local treatment will not differ, in its general principles, from that already described as applicable to acute inflammation, except as it respects the modifications arising from the presence of a broken surface. The part, as a primary and essential step, must be placed perfectly at rest in an easy and elevated position, to prevent arterial ingress and favor venous return; it will even be well, in many cases, to place the limb upon an inclined plane, so that the sore shall be higher than the rest of the body, and to confine it, if necessary, in this situation by means of a light roller, care being taken not to obstruct discharge or to make undue compression. If the part be filthy from want of cleanliness, or adherent dressings, ablution by immersion precedes direct medication. If the morbid action be high, the young practitioner might be induced to apply leeches, not to the sore, but in its immediate vicinity; but such a proceeding is objectionable, for the reason that the bites of these animals are liable to occasion excessive pain, and sometimes even an aggravation of the disease. A much better plan is to draw blood by scarification by means of a lancet, the limb, the while, standing in a tub of warm water, with a cord thrown firmly round its upper extremity, a few inches below the knee. From six to a dozen vertical incisions, not quite skin deep, are made over the inflamed surface around the sore, the blood being permitted to flow until the patient shows signs of approaching syncope, if he be at all plethoric, or, at all events, until the engorged vessels have been measurably deprived of their contents, as denoted by the comparative pallor of the part. I know of no method so well adapted as this to make a prompt and decisive impression upon an acute ulcer; it is a most potent alterant, and I rarely omit its employment whenever the case presents the slightest urgency. For the sore itself the best remedy is a weak solution of acid nitrate of mercury, in the proportion of one part of Bennett's formula to two, three, or four parts of water, according to the foulness of the affected surface. The application should be made lightly with a soft sponge or cloth mop, and may, if necessary, be repeated once in the twenty-four hours until there is a decided improvement in the condition of the ulcer, when it should be entirely dispensed with, or used more sparingly, and still weaker. As a constant cover for the part the most suitable remedy will be a light emollient cataplasm, sprinkled with morphia, laudanum, or powdered opium, or the warm water-dressing, simple or similarly medicated. Fetor is allayed with the chlorides. In some instances yeast may advantageously be added to the poultice; but in general this may be dispensed with. Under this treatment rapid improvement may usually be looked for; indeed, in many cases we have the satisfaction to find, within less than thirty-six hours after its commencement, already a decided change for the better; the ulceration evinces a disposition to cease, the discharges assume a more healthy aspect, and the surrounding parts lose their fiery red and œdematous character. By persevering in the treatment, in a modified form, the sore will soon begin to granulate, and to form new skin along the margin of the old, and this point being attained, none but the mildest applications will be required.

Such, in a few words, is an outline of the treatment which, when a choice of remedies is allowed, I usually adopt in this disease. But the patient will not always submit to scarification, nor is this always proper, owing to the exhausted condition of his system. Under such circumstances, our object may often be promptly attained by the free application of the dilute tincture of iodine to the parts around the sore, while the sore itself is lightly touched with the acid nitrate of mercury, as in the former case, or with a strong solution of nitrate of silver, or this article in substance, although both are decidedly inferior to the former remedy. In some instances I have succeeded in putting a prompt and permanent check to the ulcerative action by covering the sore and the inflamed surface with a blister, retained until thorough vesication was induced, and then using the ordinary dressings. Few cases of acute ulcers will, I am confident, be able to resist this remedy. Its beneficial effects are no doubt due to the drainage which it establishes and the consequent change in the action of the capillary vessels. The progress of the cure is sometimes embarrassed by dead matter, as shreds of cellular tissue or fibrous membrane, the removal of which should receive prompt attention.

Of creasote, sulphate of copper, acetate of lead, and other remedies so much lauded by some practitioners in the treatment of acute ulcers, little need be said. These articles undoubtedly possess some merit, and I have occasionally employed them with advantage, but as they are altogether of a subordinate character they should never take the place, in urgent cases, of those just mentioned. Acetic and nitric acid, the former in the proportion of one drachm, and the latter of eight or ten drops to the ounce of water, are excellent applications, in the milder varieties of the affection, allaying fetor and changing the action of the sore so as to promote the formation of healthy granulations and laudable discharge.

2. CHRONIC ULCERS.

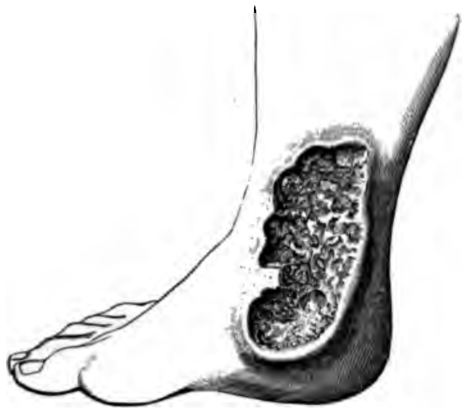
While it is not always easy to determine when an ulcer becomes chronic, it is to be borne in mind, as was previously stated, that a chronic ulcer may, in consequence of local and constitutional causes, occasionally assume an acute character. In this respect the present disease does not differ from ordinary inflammation, unattended by breach of texture. Thus, an inflammation of the conjunctiva, after having pursued a chronic march, with but little pain and discoloration, perhaps suddenly, at the end of several months, breaks out with renewed vigor, characterized by all its primitive intensity, and now rapidly urging on the affected structures to permanent disorganization, rendered the more prone to this occurrence by their protracted suffering. Ulcers are not unfrequently subjected to similar hardships; not once only, but, perhaps, many times during their progress, and thus their career often becomes a most checkered one, defying alike our powers of diagnosis and treatment, and constituting at least one of the causes, previously adverted to, of the *outré* nomenclature which disfigures this branch of the art and science of surgery.

When does an ulcer become chronic? or, in other words, what time must elapse before it can be said to possess this character? To this question it is impossible to give anything like a definite reply; in some instances the disease is chronic almost from the beginning; in others, it becomes so in a few weeks, and in others, again, perhaps several months intervene. The term chronic, as every one knows, has reference to time, and is employed to designate a class of affections which have passed through their acute stages, and which, consequently, have been deprived of their primitive characteristics; their action has been modified by treatment, or by the operation of time, or the joint influence of both. The inflammation now generally exists in a much milder form; there is less functional disturbance, while the constitutional derangement often entirely ceases, and the local phenomena of heat, redness, pain, and swelling are materially diminished. The part, however, is oppressed, if not overpowered, by effused fluids, its vessels are sluggish, dilated and engorged with dark blood; nervous sensibility is perverted, and the restorative tendency is either much enfeebled or else completely at a stand. Ulceration still goes on, and perhaps even serious havoc is committed by its action, but that action is tardy, and exhibits few, if any, of the phenomena which characterized it in the first instance. It would seem, at first sight, as if it were a paradox to say that a disease was chronic from its commencement, and yet such is, nevertheless, the fact, rather, however, in reference to its symptoms than in regard to the true and legitimate meaning of the word. But upon this subject I have already dwelt at some length in a former chapter, and I shall therefore not enter into any minutiæ respecting it here.

Chronic ulcers often exist for many months and years together; at one time stationary, now receding, and now advancing; in one case exhibiting too much action, and in another too little, but rarely in a condition to furnish the requisite amount and quality of reparative material. Even if granulations occasionally do form, they are seldom of a healthy character, or, if they are, it is seldom that they long retain it; on the contrary, they soon languish for the want of proper support, or they perish from the violence of the attendant inflammation. These effects may be the result purely of local causes, or of causes exerting their influence indirectly through the constitution; but in the majority of cases they are, there is reason to believe, the consequence of the operation of both. If this statement he true, as multiplied observation proves it is, we cannot fail to deduce from it important principles of practice. It plainly suggests to us the necessity, in every instance, of instituting a careful inquiry into the nature of the exciting cause and the condition of the system, as well as the state of the part itself. To treat a chronic ulcer upon any other plan would be a palpable absurdity; and yet that this is generally the case my experience amply attests. Few practitioners look upon this class of diseases in the true light of philosophy; their ideas of their pathology are vague and indistinct; and it is therefore not surprising that they should find themselves completely baffled in their attempts at curing them. It is for this reason that chronic ulcers of the legs have so long been regarded as an opprobrium of surgery, and that so many patients are obliged to carry their malady with them to the grave, notwithstanding the numerous attempts that may have been made to get rid of it; all arising from the fact that its true nature was never properly understood.

The chronic ulcer is capable of assuming every possible variety of seat, number, form, size, color, condition of surface, and complication. In general, it is found to occupy the inner surface of the leg, a few inches above the ankle; but it is often situated higher up, and in rare cases it is placed directly over the joint itself. The outer surface of the limb is also liable to suffer, and we occasionally meet with instances of ulcers existing simultaneously upon both sides. In fact, no part of the leg is wholly exempt from the disease, unless it be that just below the knee. Why this liability should exist to a greater extent at one point than at another is a circumstance which we are unable to explain. Is it owing to the fact that the inner surface of the limb is more liberally supplied with veins, and, consequently, more subject to habitual congestion of the skin and cellular tissue? Such an idea is not improbable, but whether it is correct, we have no means of determining.

Fig. 20.



Chronic ulcer with deep edges, partially undermined, and a foul unhealthy bottom, studded with fungous granulations.

The form of the ulcer is variable, being at one time circular, now oval, and then angular, or so irregular as to defy all attempts at accuracy of description. In some cases, it extends round the limb in the form of a belt nearly of equal width. In size it ranges from that of a five-cent piece to that of the palm of the hand, or even the entire hand, the destruction of substance being truly frightful. In its depth, it rarely reaches beyond the subcutaneous cellular tissue; in some cases, however, it involves the aponeuroses, the muscles, and even the bones and cartilages. Such ravages generally imply an unusual amount of antecedent inflammation, or the repeated intervention of acute action, although they are often produced by the steady progress of the chronic disease itself.

The chronic ulcer is often solitary; but it is not uncommon to meet with two, three, or even a larger number, situated either in close proximity with each other, or at different, and perhaps rather remote points of the limb. When the number is considerable, their size is usually proportionably small.

The color of the ulcer varies from light rose to deep purple, according to the intensity of the concomitant action and the congested condition of the cutaneous capillaries. The most common shades of color are the dusky, brownish, and light livid, but it is worthy of note that an ulcer which is of a rosy hue to-day may be of a deep purple to-morrow, simply in consequence of a change in the condition of the inflammatory action. The parts around the sore are often quite as high-colored as the sore itself; sometimes, indeed, much more so. In general, the discoloration, whatever may be its character, is lost by insensible gradations in the surrounding healthy hue, not abruptly, as in erysipelas and erythema.

In regard to the edges of the chronic ulcer, nothing can be more diversified; hence, some of the singular distinctions of Home, Astley Cooper, and others who have followed so closely in each other's footsteps. In general, the edges are hard or callous, elevated, rather broad, and so insensible as to admit of the rudest manipulation; in some cases, they are thin, ragged, almost serrated, and either everted or inverted, and perhaps exquisitely sensitive. In another class of cases, by no means infrequent, they are considerably undermined, or shelving at one point and everted at another. In fact, there is no end to the diversities presented by the boundaries of the sore; hence, all attempts at description must be futile.

The surface of the sore is generally more or less irregular, being deeper at one part than at another, although, as was before stated, it rarely extends beneath the subcutaneous cellular tissue. Its real condition usually varies with the amount of inflammatory action. When this is considerable, there is often an entire absence of granulations, and then the bottom of the sore will generally be found to be in a foul, bloody, or phagedenic condition, or incrusted with a stratum of lymph too feeble to admit of organization; or, finally, granulations, sloughy matter, and vitiated plasma may all be present, in varying degrees, upon different parts of the exposed surface. The concomitant discharge is profuse, sanious, fetid, and irritating, possessing none of the properties of healthy pus. The sore, as well as the surface immediately around, is unusually sensitive, and often the seat of severe pain. It is to this form of ulcer that writers usually apply the term inflamed, or irritable, from its excess of vascular and nervous activity. It is most common in nervous, irritable subjects, and in persons who are habitually intemperate. It is of frequent occurrence.

When the inflammation is more moderate, granulations will seldom be wholly absent, and they may exist even in great abundance, although they may be altogether unhealthy in their character. When the action is somewhat less, but not too languid, they commonly exhibit a pale, reddish, flabby appearance; their surface is irregular or tuberculated, and they are much too large; in fact, they look as if they had been reared in a hot-bed, and had been too freely watered. Their reparative power is very feeble, and we are often obliged to get rid of them entirely before we can effect a cure. This state of granulation constitutes what is vulgarly called "proud flesh," and is often difficult to manage.

Again, the circulation may be inordinately languid, and then the granulations, if any be present at all, will generally be still larger than in the preceding case, totally insensible, and perhaps quite œdematous, a serous, or sero-sanguinolent fluid freely exuding from them if punctured, and readily pitting under pressure. Cacoplastic lymph is generally interspersed through the granulations, or adherent to the surface of the sore, the edges of which are hard and very prominent, so that the raw surface appears as if it were much below the level of the surrounding parts, which, however, is seldom the case. The accompanying discharge is slight, thin, and sero-sanguinolent; and the adjoining skin is œdematous and of a dusky-brownish hue.

Finally, cases occur where the granulations are very small, or apparently stunted in their growth, irregular in shape, of a fiery red color, and so exquisitely sensitive as to be a source of great suffering, the ulcer being intolerant of the slightest pressure, or manipulation; the discharge is sanious and irritating, although seldom very fetid or profuse; the edges of the sore are thin, irregular, everted, or inverted; and the surrounding skin is the seat of active inflammation.

The chronic ulcer is often complicated with other diseases, which tend to modify its action, and impede, if not entirely prevent, its restoration. Of these affections some are of a local, others of a general character. The former consist mainly in the involvement of the deep-seated structures, as the fibrous membranes, tendons, muscles, and bones; in the formation of sinuses; in a varicose state of the veins; and in the presence of foreign matter, under the influence of which the ulcer was, perhaps, originally induced. Among the constitutional complications the most common are, disorder of the secretions, especially of the liver and alimentary canal, anemia, dyspepsia, plethora, and habitual intemperance in eating and drinking. I have never seen what writers have called the menstrual ulcer, although it is not to be doubted that great uterine derangement, showing itself in deficiency of discharge, might seriously interfere with the healing of a sore on the leg, or, indeed, in any other part of the body.

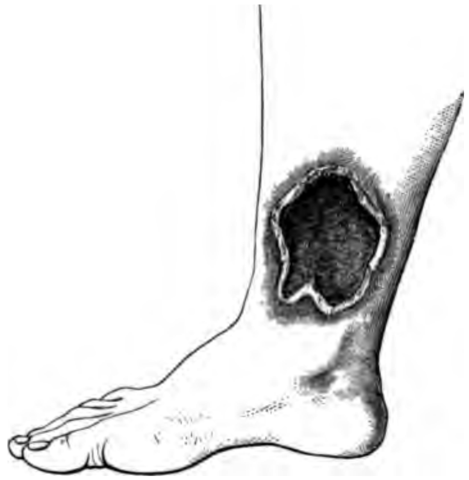
Treatment.—In the management of chronic ulcers three leading indications or variously weakened, according to the exigencies of each particular case. One application of the acid will usually suffice in the twenty-four hours, and in many instances the cure will progress more rapidly and satisfactorily if it be made less frequently. Other topical remedies may often be used with advantage, especially the nitric acid lotion, and weak solutions of sulphate of copper, acetate of lead and zinc, sulphate of zinc, creasote, and acetic acid. All these articles, however, are of a subordinate character, and hence I seldom have recourse to them. As a constant protection for the parts, nothing is more suitable than the elm or linseed cataplasm, which, notwithstanding the abuse that has been heaped upon it in certain quarters, is still, in most cases, one of our nicest and most reliable remedies. Or, instead of the poultice, the warm water-dressing may be used, although this is generally much less convenient in private practice, and not any better. When the pain is very great, the application should be medicated with solutions of morphia, or morphia may be sprinkled directly upon the surface of the ulcer.

During all this time proper attention is to be paid to the state of the system; the bowels are to be regularly moved with mild aperients, and care is taken that the diet is perfectly mild and not over nutritious. If the general health is much disordered, recourse is had to more active purgation, and free use is made of the antimonial and saline mixture, with a full opiate at night, if there be much pain, or inability to sleep. Bleeding at the arm will only be required in very plethoric subjects, in urgent cases. Absolute recumbency is observed, at least until the morbid action has been measurably subdued; and the affected part is placed at rest in an easy and elevated position, just as in ordinary cases of inflammation.

If the general health is much reduced by protracted suffering, or if the system is in an anemic condition, or, finally, if typhoid symptoms are present, stimulants and tonics will be indicated, especially quinine, with milk punch, and nutritious food.

If the measures now detailed be judiciously employed, the surgeon will soon be able to get the ulcer into a condition for the development of healthy granulations, fig. 21, and, as soon as this has been brought about, he will have little else to do than to watch the parts, with a view to the prevention of over-action. The mildest and most soothing applications will now generally suffice, the object being rather to protect the surface of the sore from the injurious contact of the atmosphere, than to promote its action by medicative agency. Among the best of these remedies are the cerates of opium, balsam of Peru, oxide of zinc, and, last, but not least, of the nitrate of mercury, which I prefer to all others, on account of its cicatrizing properties. It must, however, be employed with care, and in a very weak form, as in the proportion of six, eight, or ten grains to the drachm of simple ointment. The scabbing process may occa-

Fig. 21.



Granulating ulcer, beginning to cicatrize; the process extending from the periphery towards the centre.

cleansing the sore, as well as sprinkled from time to time upon the poultice and bandage.

When a large extent of integument has been destroyed by the ulceration, or when the morbid action has a constant disposition to reappear, as so often happens, upon the imperfectly organized cicatrices of old sores, it has been proposed to cover the breach by borrowing the requisite amount of tissue from the immediate neighborhood, just as in the more ordinary plastic operations. The plan, which has been dignified with the name of *elkoplasty*, has been warmly advocated by Professor Hamilton, of Brooklyn, in a short article which he published upon the subject in the New York Journal of Medicine, for 1854, in which he describes several cases of its successful employment. Dr. John Watson, of New York, had previously applied the same principles of treatment in a case of syphilitic ulcer of the forehead, the particulars of which will be found in the American Journal of the Medical Sciences, for October, 1844, under the name of mylopoplasty. To insure the union of the edges of the wound, it is necessary that the part should be quite free from inflammation, and that the general health should be as nearly as possible at the natural standard. The flap should be much larger than the gap in the limb, and should be well secured in its new position by the interrupted suture.

Whatever mode of treatment be employed, it is of paramount importance, as it respects the prevention of relapse, that the patient should observe great care in regard to his diet and exercise, for a number of weeks after the ulcer has completely healed. If he indulges his appetite too soon, neglects his bowels, or allows his secretions to become disordered, he can hardly escape a new outbreak of the disease, especially if, at the same time, he fatigues his leg much, lets it hang down constantly, constricts it improperly with his garter, rubs it with his boot, or permits it to become covered with filth. Cleanliness, indeed, cannot be too rigidly insisted upon as a means of promoting a restoration of healthy action. The parts should be thoroughly washed at least once a day with soap and water, and then sponged with some alcoholic lotion, to revive and invigorate their exhausted powers.

In inveterate cases, extensively involving the osseous tissue, greatly impairing the general health, and resisting the best efforts of the surgeon for their relief, the only resource is amputation, performed through a sound portion of the limb. I believe, however, that such a procedure will rarely be demanded in these days of conservative surgery; for, unless the bone be almost entirely destroyed, it will be easy, in the majority of instances, to dispose of the diseased structures with the knife, gouge, and mallet; or by a resort to resection.

In conclusion, we may ask the question whether it is always safe and proper to heal old ulcers? Upon this subject, various opinions have been expressed by writers on surgery. Those who assert that it is not, assume that a sore of this kind acts, when it has existed for a great length of time, as an issue, which serves the purpose of a safety-valve to the system, by ridding it of redundant, if not positively peccant, humors. They allege that cases have occasionally been witnessed where attacks of cerebral apoplexy, and other serious diseases, have occurred as the direct and speedy consequence of the drying up of such sores. Those, on the contrary, who espouse the opposite side of the question, declare that such occurrences are mere acccidental circumstances, readily explicable by the laws of coincidence; and such is the view which I am myself inclined to adopt. I do not believe that medical science possesses any well-authenticated facts by which this opinion can be sustained. I have often cured ulcers of five, ten, and even fifteen years' standing, constantly attended with more or less discharge and irritation, and yet it has never fallen to my lot to meet with a solitary instance to which such an event could justly be ascribed. Besides, the constitutional treatment cells, without any very definite arrangement, and connected by a small quantity of intermediate substance, the precise nature of which is not understood. It is usually of a florid color, very vascular, extremely sensitive, and of a conical, rounded, or oval shape, its volume varying from that of a clover-seed to that of a large shot. Minutely studied, it is found to consist, as seen in fig. 23, of numerous vessels, which are evidently sent into it as outgrowths from those of the adjacent parts, being arranged in the form of beautiful loops and arches, closely interwoven with each other. As they are developed with great rapidity, their walls are at first so extremely delicate as to yield under the slightest pressure; hence there is generally more or less hemorrhage from whatever is brought into rude contact with them. The veins, which are very large, exhibit, when viewed with a magnifying lens, a remarkably tortuous and convoluted appearance. No nerves are demonstrable in this body, but that it receives an abundant supply of this kind is shown by the fact that it is often very sensitive, especially when it is in a state of disease. The existence of lymphatic vessels is also a matter rather of inference than of positive observation. Experience has proved that certain articles, placed in contact with a granulating ulcer, will be promptly taken up, and carried into the system, producing the same effect, and nearly in as short a time, as when introduced in the ordinary manner. Thus, morphia will readily allay pain and induce sleep; atropia, dilate the pupil; arsenic, irritate and inflame the stomach; strychnia, convulse the muscles. Moreover, a granulation is a secreting body, a kind of compound gland, capable of pouring out plasma and providing the elements of pus; the former for enlarging its own dimensions and multiplying itself, the latter as a means of defence from the atmosphere and from the surgeon's dressings.

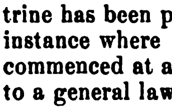
Granulations form with various degrees of facility, depending mainly upon the structure of the part and the amount of inflammatory action. Ulcers of the skin and cellular tissue always, other things being equal, furnish them most readily, as well as in most abundance; a circumstance which is not surprising when we reflect upon their extreme vascularity and high nervous endowment. Bone, cartilage, tendon, and fibrous membrane, on the contrary, granulate more slowly, and hence their injuries are always repaired with more difficulty. The same remark applies, but in a more pointed manner, to scirrhous and other malignant ulcers.

Granulations are liable to disease. This often occurs from causes apparently the most insignificant; depending, perhaps, at one time upon the state of the part, at another upon the state of the constitution, or upon both combined, but more frequently upon the nature of the dressing, and the indiscretion of the patient. Hence, the appearance of these bodies usually serves as an index of the concomitant action, local and general, and affords useful indications of treatment. The most important alterations which they undergo are such as relate to their size, color, consistence, and sensibility. Healthy granulations are generally small, not exceeding the volume of a mustard-seed, but cases occur in which they are many times larger. Their natural color is a beautiful florid; when congested or inflamed they assume a livid aspect, while under opposite states they are occasionally quite pale, or even blanched. In their consistence these bodies also present much diversity, being sometimes very soft and lacerable, and at other times very firm, inelastic, and almost callous. Occasionally they have an infiltrated, œdematous, or dropsical appearance, serum escaping freely upon the slightest puncture. Their sensibility is usually very feeble, but in nervous, irritable persons they are sometimes exquisitely sensitive, particularly when they happen to be much inflamed. In ulcers from burns the granulations are always distinguished by their excessive tenderness.

The discharge furnished by these bodies is liable to vary in different cases new substance to obtain a proper foothold. I am aware that a different doctrine has been promulgated by some, and there is, no doubt, occasionally an instance where the process proceeds in an opposite direction, after having commenced at a central point; but if this be so, it forms merely an exception to a general law, and not the law itself. Those who assert that this occurrence is rather frequent than otherwise may have been deceived by the existence of a small fragment of old tissue, with or without integument, which, standing like a little island in the midst of the ulcer, thus becomes the nucleus of the new structure. In this event, however, there is obviously no new law in force, but simply an application of the one already described.

Some time necessarily elapses, after the cicatrization is completed, before the new structure, now called a *cicatrice*, acquires much solidity and strength. It is only by degrees that it loses its bluish appearance and assumes the properties of the pre-existing substance. Even then it is at best only a very imperfect copy of the original, although it is capable of supplying its place and of executing the functions which nature has allotted to it. Its vessels, which are, at first, remarkably large and tortuous, gradually dwindle down to a size approximating them to those in the adjacent sound parts, and, when fully formed, they generally exhibit a beautiful retiform arrangement, as is shown in the annexed sketch, fig. 24. The scar always remains tender for a considerable period after its formation, and is usually very liable to break, crack, or ulcerate from very slight causes. Its tendency to contract or diminish also continues for a while longer.

Fig. 24.



Structure of a cicatrice of the skin.

What I have said respecting the imperfect reproduction of skin is equally applicable to the other textures. New bone comes perhaps nearer to the original structure than any other; but even this presents many peculiarities, and it is certain that it often acquires a degree of hardness and solidity far greater than the primitive substance. There are, moreover, some pieces of the skeleton which, when broken, never unite by osseous matter, but only through the medium of fibrous tissue, fibro-cartilage or cartilage. Fractures of the patella, the olecranon, the acromion process of the scapula, and the neck of the thigh-bone within the capsular ligament, are generally, if not always, repaired in this way, the parts not having the power of secreting phosphate and carbonate of lime, in consequence of their imperfect supply of blood and nervous influence, to say nothing of the difficulty of maintaining the ends of such fractures in contact for a sufficient length of time to afford them an opportunity of becoming consolidated. Cartilage is never perfectly reproduced after injuries; the new substitute is always very thin, hard, and of an unnaturally bluish tint. Tendon is renewed only in the case of subcutaneous section; never when it has been lost by disease. Muscles usually unite through the medium of fibro-cellular substance. In fracture of the costal cartilages the consolidation is effected by bone. Bloodvessels and nerves are never regenerated; the continuity of the former cannot be re-established after complete division, on account of the retraction of their extremities; if a small piece of the latter is excised, the gap is supplied by fibrous tissue, very different from the pre-existing one, but, nevertheless, often sufficient to transmit the nervous fluid with little or no impairment of its influence. The cerebral, pulmonary, hepatic, splenic, salivary, renal, and seminiferous structures are incapable of reproduction, the new substitute being always of a cellulo-fibrous, .or fibro-cartilaginous nature. Serous, mucous, and fibrous membranes are repaired in a similar manner. Thus it will be seen that a tissue, when seriously mutilated, is seldom perfectly reproduced, whatever pains may be taken to assist its efforts.

It is not surprising that a substance so imperfectly organized as a cicatrice

CHAPTER V.

TEXTURAL CHANGES.

UNDER this head may be described those organic changes which are effected in the substance of the organs and tissues, as the result either of inflammation or of defective nutrition, consequent upon lesion in the circulatory and nervous systems. The most important of these alterations of texture are softening, induration, transformations, hypertrophy, atrophy, contraction, and fistule.

SECT. I.—SOFTENING.

Inflammation not unfrequently passes into softening, or what the French pathologists have denominated ramollissement. The event is characterized by a loss of cohesion of the affected textures, varying in degree from the slightest change of the natural consistence to almost complete pulpifaction. All parts of the body are liable to this occurrence, but those which are most apt to suffer are the lungs, brain, spleen, liver, and heart, together with the mucous membrane of the stomach and bowels, the articular cartilages, and the spongy structure of the bones. The subcutaneous and inter-muscular areolar tissue is occasionally softened to a great extent in rapidly progressive forms of inflammation, particularly in diffuse erysipelas. The vessels, nerves, muscles, and tendons, the fibrous and serous membranes, the lymphatic and salivary glands, the kidneys, the thyroid body, uterus, ovaries, testes, and prostate rarely experience this alteration under any circumstances, however violent the attendant action.

Softening sometimes takes place rapidly, at other times slowly; hence the distinction into acute and chronic. In the former case the affected tissues may be almost completely deprived of their natural consistence within the space of a very few days. Thus, in acute pneumonia the lungs are often so much softened at the end of three or four days as to be incapable of resisting the slightest pressure of the finger. In the brain and spleen the loss of cohesion sometimes proceeds even more rapidly than in the lungs. Chronic softening is most common in the cerebral substance and in the mucous membrane of the ileum and colon, where it is generally a most insidious disease, often involving a large extent of tissue, and yet unaccompanied by any characteristic symptoms.

The true nature of softening has not been explained. We can hardly, however, divest ourselves of the idea that it is not a species of molecular mortification, especially in its more advanced stages. Be this as it may, it is unquestionable that the loss of cohesion, under such circumstances, is entirely incompatible with the exercise of the functions of the part, or its restoration to health. Many of its smaller vessels are completely obliterated, while the remainder are so crippled and paralyzed as to be scarcely able to propel their contents. Changes not less conspicuous are observable in the proper parenchymatous structure, which not only loses its natural consistence, but also its natural color; its cells are infiltrated with serosity, or serosity, lymph, pus, and blood, and its minute texture is no longer distinguishable by the aid of the most powerful microscope. If this is not death, or a condition closely approximating to it, what can it be? In the milder forms of mollescence the structure may still retain some vitality, and may, consequently, be able, in time, to regain its original characters; or, what is more probable, may be rebuilt by plastic matter, after the manner of other broken-down and mutilated tissues, the first step in the process being the removal of the effete substance.

There is a species of softening which is intimately connected with, if not dependent upon, obliteration of the vessels of the affected structures, with a consequent deficiency of blood and an impairment of nutrition. It is most frequently met with in the brain and spinal cord of old persons, and is generally supposed, although, as I think, erroneously, to be of a non-inflammatory character. If this opinion were correct, it is not probable that we should find, as we always do in this disease, more or less effusion of serum, plasma, and even pus. Wherever these fluids are deposited they afford indubitable evidence of incited action; hence it would be folly to conclude that they could be poured out here without inflammation.

This event of inflammation is interesting chiefly in a pathological point of view; for, as it is met with almost exclusively in the internal organs, and presents no characteristic symptoms, it is evident that treatment holds out little prospect of relief. When the true nature of the lesion is suspected, the proper remedies, in the acute form, will be such as are calculated to reduce inflammatory action and favor the removal of deposits; in the chronic variety a mildly alterative course, with tonics, embracing cod-liver oil, quinine, and iron, is indicated.

SECT. II.—INDURATION.

It has already been seen that a deposit of lymph, plasma, or plastic matter is common to nearly all inflammations, whatever may be their cause, site, or degree. When occurring upon the free surfaces of the organs, it usually presents itself in the form of a layer, which, escaping the influence of the absorbents, is ultimately converted into an analogous tissue, which often remains during the rest of the individual's life, being subject, in the meanwhile, to all the diseases and accidents incident to the pre-existing structures. When the deposit takes place in the substance of the organs, it fills up their cells, interstices, or molecular spaces, and thus increases their consistence, as well as their weight, the matter assuming the shape of the cavities in which it is lodged, and being liable, as in the former case, either to be absorbed or to become organized, according to the condition of the part and the vitality of the morbid product. A similar arrangement occurs when plasma is effused into the cellular tissue beneath the skin, among the muscles, and in other situations.

Induration is extremely common, and may occur in any organ and tissue of the body. It is most frequently met with, however, in the lungs, spleen, liver, thyroid gland, testicle, the lymphatic ganglions, the prostate gland, the mamma, ovaries, uterus, bones, and subcutaneous cellular structure.

Age exerts considerable influence upon the production of induration. In the great majority of the organs it may take place at any period of life, but in some, as in the thyroid gland, for example, it rarely occurs before the fourteenth year, while in the genital apparatus it is hardly ever observed until after puberty. Induration of the prostate gland, of the vessels, and of the brain and spinal cord is an affection of advanced life, as is also induration of the crystalline lens and its capsule.

The degree of induration varies from the slightest alteration of the natural consistence of the part to the solidity and density of concrete albumen, old cheese, fibro-cartilage, cartilage, or bone. Much, in this respect, will depend upon the nature of the affected tissue, and the date of the lesion, or the degree of change which the deposit upon which the induration depends may have undergone. The color of the affected part may be normal, or variously altered, according to the amount of its vascularity and the presence or absence of effused blood. Much diversity also exists in regard to its volume, although in most cases this is considerably augmented, and sometimes even quite enormously, the bulk many times exceeding that which is natural to the organ in health. The weight of the part, too, is usually increased, and there is commonly more dryness, with a marked loss of elasticity.

The period required forthe production of induration ranges from a few hours to several days, weeks, or months, depending upon the nature of the exciting cause and of the affected structures. In the testicle it often occurs in a very marked degree in less than twenty-four hours, and at the end of forty-eight hours the organ may be so hard as to be entirely incompressible. The induration accompanying the development of tonsillitis, adenitis, furuncle, carbuncle, and erysipelas generally occurs with extraordinary rapidity; and the same thing is frequently witnessed in the cellular tissue around the joints, especially in inflammation of a gouty or rheumatic character. In pneumonitis the parenchymatous substance of the lungs is often extensively solidified within a few days from the commencement of the morbid action. On the other hand, the induration may proceed very slowly, as in goitre, in chronic arteritis, hepatitis, and splenitis, and in certain affections of the uterus and prostate gland, where months, if not years, may elapse before it attains its full development.

The effect of induration upon the tissues in which it occurs is of the most prejudicial character, sadly impairing their structure and functions, and frequently leading to the worst results. Thus, when it affects both testicles it may become a cause of impotence; in the liver it may interfere with the secretion of bile; and in the lung it may produce death by offering a mechanical obstruction to the ingress of the air. In the arteries induration is frequently followed by rupture of their coats, leading to aneurism; while in the cellular tissue around the joints it always impedes the exercise of the articular surfaces.

The immediate cause of induration is a deposit of plastic matter into the cells of the affected structures, which it thus obliterates while it condenses the adjoining substance, and so renders it unfit, either temporarily or permanently, for the proper exercise of its functions. The fluid is generally associated with more or less serum, and not unfrequently also with pus, and even pure blood. When the circumstances under which it is deposited are favorable, it soon becomes organized, and may finally be converted into an analogous tissue, which often retains its parasitic connection during the remainder of life, although in most cases it ultimately disappears.

In the treatment of induration the leading object is to excite the absorbent vessels so as to induce them to remove the deposits upon the presence of which the lesion depends. It need hardly be said that the sooner this is done the better. The longer we wait, the greater will be the danger of a permanent change of structure, or, when the organ is one of great importance to life, of the death of the patient. When the deposit is recent, and action still high, our reliance is mainly upon the vigorous employment of antiphlogistics, such as bleeding, purging, and diaphoretics, with antimonials, light diet, and perfect rest in the recumbent posture. Inflammation having thus been moderated, the induration, already greatly reduced by the previous measures, may usually be promptly disposed of by alterative doses of mercury, carried, perhaps, to slight ptyalism; and, where the part is accessible, by sorbefacient liniments, embrocations, and unguents, aided by pressure with the bandage. In the more chronic forms of the affection the different preparations of iodine must be brought in play, particularly Lugol's solution, Donovan's liquor, and the various forms of mercury, as the bichloride and biniodide; along with the topical applications just mentioned, if the induration be external. Friction and the cold douche will also prove serviceable under such circumstances.

SECT. III.—TRANSFORMATIONS.

The human body is in a state of constant mutation, of decay and renovation, commencing before birth, and continuing down to the last moments of existence. The Wolffian bodies and the gubernaculum of the testicle disappear during intra-uterine life; the thymus gland is gradually effaced during childhood; the arteries ossify in elderly persons; and at every period of life various states of the system, depending upon disease or accident, arise, in which there is a strong tendency to the deposition of oil globules, or the transformation of different organs and tissues into fatty matter.

The most important of these changes, surgically considered, are the cellular, mucous, cutaneous, fibrous, calcareous, and fatty; they are all connected with defective vitality, and with atrophy of some, if not all, of the constituent elements of the affected structures.

The cellular transformation is met with chiefly in parts that have been rendered useless, either from the natural cessation of their functions, or in consequence of accidental circumstances. Thus, the thymus gland, which is evidently connected with some important office in the fœtus, gradually decays during childhood, being converted into shreddy cellular substance, of which hardly a trace remains after the thirtieth year. The gubernaculum undergoes a similar change; the gall-bladder, occluded by biliary concretions, is occasionally completely transformed into this tissue; and the cellular adhesions so often seen between the costal and pulmonary pleuræ, consequent upon the degeneration of old adventitious membranes, are familiar to every pathologist. Various ligaments, especially the capsular, sometimes degenerate in this way; the metamorphosis is most marked in young subjects affected with unreduced dislocations of the hip and shoulder.

When skin is inverted for any length of time into one of the natural outlets of the body, as, for instance, the anal, it gradually undergoes a species of metamorphosis into mucous membrane. The first indication of the change is a softened condition of the cuticle and the disappearance of the hair; the epidermis scaling off, the surface beneath assumes a reddish, velvety aspect, becomes extremely vascular, and soon begins to secrete a thin, ropy, whitish fluid, not unlike mucus.

A change from mucous membrane to skin is sometimes observed, although the occurrence is uncommon. It is noticed chiefly in prolapse of the rectum, vagina, and uterus, the mucous investment of which, from long exposure to the atmosphere, becomes dry, rough, and insensible, and is ultimately converted into a tissue bearing a more close resemblance to the cutaneous than the mucous. The transformation, however, as in the case of the skin, is at best extremely imperfect, and it remains to be shown whether, in either instance, the old structures are so completely deprived of their identity as to justify the idea of a genuine transformation.

The *fibrous* transformation is most commonly met with in those parts of the body that have been deprived, either accidentally or otherwise, of their natural functions. Thus, in an artery that has been tied for the cure of aneurism or the arrest of hemorrhage the portion of the vessel included between the ligature and the first large collateral branch is gradually converted into a solid cylinder, which, in its turn, is changed into a dense, fibrous structure, in which it is impossible to discern any trace whatever of the primitive tissues. Ligaments, serous membrane, and adventitious textures occasionally undergo similar changes. The cornea, in the withered and atrophied eye, the victim of destructive inflammation, seems, at times, to be almost completely transformed into a substance bearing the closest resemblance to the sclerotica, one of the best examples of the fibrous tissue. In some of these cases, as in that just mentioned, the change is accompanied by a deposit of oil globules. The whitish opaque bodies, so frequently observed in the coats of the spleen, in the placenta, and in the arteries of elderly subjects, are apparently essentially composed of fibrous substance, although in their outward characters they strikingly resemble fibro-cartilage.

The *calcareous* degeneration is most common in the arteries, but is also occasionally seen in other parts of the body, as in fibrous tumors, especially those of the uterus, in the articular cartilages, and in the concretions sometimes found in the larger joints, particularly that of the knee. In the arteries it generally begins in the form of little opaque patches, in the cellular substance between the inner and middle tunics, which, as they advance in age, assume a firm, solid consistence, and ultimately convert the vessels into rigid earthy cylinders. The deposit—for such is its nature, rather than a genuine degeneration—was formerly supposed to be of an osseous character, but recent researches have shown it to be altogether different, both in its chemical and physical properties. In the more matured specimens it is essentially composed of carbonate and phosphate of lime, in union with a minute portion of albumen; in recent cases, on the contrary, the animal matter exists in much greater quantity. It differs still further from bone in having no areolar structure, and in being destitute of vital properties. In fibrous tumors of the uterus large calcareous masses, weighing several pounds, are occasionally found.

The *fatty* degeneration, if not the most common of all, is the most universally distributed, since there is hardly any organ or tissue of the body in which, under favorable circumstances, it may not occur. Recent observation has demonstrated that it may take place in the lungs, in cartilage, in bone, the placenta, the cornea, and the crystalline lens. It is also met with in plastic exudations, tubercles, cancerous growths, and even, it is supposed, in pus globules. It has long been known to be of frequent occurrence in the muscles, and within the last fifteen years its presence has often been detected in the coats of the arteries, in connection with the atheromatous deposit. Thus it will be perceived that the fatty degeneration may take place both in natural and in adventitious formations; in the hard as well as in the soft, in the most humble as well as in the most exalted in point of organization and life-power. Of all the various structures, however, which are liable to suffer from this lesion, the liver and arteries are probably most frequently affected. The former may undergo the fatty degeneration at any period of life, even in young children, and is a very common consequence of habitual alcoholic stimulation; the latter, on the contrary, is usually restricted to elderly subjects. The senile arc of the cornea is most common in advanced life, and is supposed by some recent observers, amongst others by Mr. Canton, to be almost always coincident with fatty degeneration of the heart and other organs. Fatty degeneration of the muscles occurs both in the voluntary and involuntary classes, although it is by no means so common in the latter as in the former.

The fat in this degeneration occurs occasionally in a free state, in the form of oil globules, cholesterine, and amorphous fragments, and is then essentially a deposit occupying the intercellular structure of the tissues. Such a superaddition of fat is often observed in the liver, arteries, brain, and pancreas.

SECT. IV.—HYPERTROPHY.

The word hypertrophy is employed to designate the increased size and weight which an organ acquires in consequence of an augmentation of its nutrition or the deposit of plastic, organizable matter into its interstices. Its use was originally restricted to those preternatural enlargements which are so frequently met with in the heart and thyroid gland; but modern observation has shown that it is applicable to all organs and tissues characterized by an unusual development of their substance.

Hypertrophy may be general or local, and the latter may either occupy an entire organ or be limited to particular portions of it, or even to some of its component elements. It may exist alone or in association with other lesions, and is liable to occur at all periods of life; sometimes, as in the thymus gland and capillary vessels, apparently even before birth. No organ or structure is probably entirely exempt from it; but among those which are most frequently affected may be specified the lymphatic ganglions, the mamma, thyroid gland, spleen, liver, heart, prostate gland, tonsils, bones, vessels, adipose tissue, and skin. The best example of hypertrophy of the cutaneous textures is elephantiasis, in which the increase of weight and bulk is sometimes enormous.

The causes of hypertrophy are, first, inordinate exercise of an organ; secondly, mechanical obstruction; and, thirdly, chronic inflammation.

The most simple way, apparently, in which hypertrophy of an organ occurs is from an increase of its functional activity. Examples of this variety of the affection are found in various textures of the body, particularly in the muscles, lungs, and kidneys. In every part of the frame, the muscles are proportionate, in size and structure, to the efforts required from them; and it is a law of nature that, whenever they are frequently called into action, their fibres become considerably augmented in thickness, and capable, consequently of much greater exertion. Thus the blacksmith, who constantly uses his arms in striking with his hammer, has much larger and stronger muscles than the dancing-master, who merely employs his legs. The same is true with regard to the lungs and kidneys. When one of these organs is imperfectly developed, compressed by effused fluid, or destroyed by some morbid growth, the other is sure to become preternaturally expanded, thereby compensating for the deficiency. There are certain viscera which are subject to temporary hypertrophy. Of this description are the uterus and mammary gland. During pregnancy and lactation these organs increase very much in bulk, but again diminish soon after parturition and weaning.

Hypertrophy may be caused, secondly, by some mechanical impediment interfering with the due performance of the functions of an organ. This is frequently seen in the heart, where, in consequence of disease of the valves, preventing the easy passage of the blood, the viscus is obliged to undergo increased action, and so becomes more or less enlarged. In the muscular fibres of the stomach, the same change is often witnessed from obstruction at the pylorus, and in those of the urinary bladder, from stricture of the urethra, or hypertrophy of the prostate gland.

Hypertrophy from chronic irritation is of frequent occurrence, and is met with under a great variety of circumstances. Some of the best examples of this species of hypertrophy are seen in the lymphatic ganglions of the groin from chronic irritation of the head of the penis, of those of the mesentery from ulceration of the ileum, and of those of the bronchiæ from disease of the lungs. Enlargement of the liver and spleen, sometimes of enormous size, is unquestionably due to a similar cause. In chronic dysentery, not only the mucous and submucous cellular textures become hypertrophied, but the affection often extends to the muscular tunic, which occasionally attains an extraordinary degree of development. The follicles and villosities, which, in the healthy state, are hardly perceptible to the naked eye, are also rendered extremely prominent, the former being sometimes of the size of a mustard-seed, the latter more than a line in length. A similar development is frequently observed in the coats of the urinary bladder, in consequence of chronic inflammation.

Encysted tumors of the skin, mucous membranes, ovaries, and some other parts of the body, are evidently mere enlargements of the glands, cysts, and cells which naturally exist in these structures in consequence of chronic irritation or inflammation. The manner in which some of these tumors are formed is easily understood. Thus, in the skin-follicle, the first step in the development of the morbid growth is an obstruction of its orifice, thereby interfering with the evacuation of its natural secretion. This being retained, becomes materially altered in its properties, at the same time that it presses everywhere upon its sides; thus two sources of irritation are set up—altered and retained secretion and constant pressure—under the influence of which the little follicle often expands into a considerable sized tumor. The mucous tumor is formed in the same manner. The enormous ovarian growths, so often seen in elderly women, are frequently, if not generally, mere enlargements of the so-called Graafian vesicles consequent upon chronic disease.

The color of the affected organ varies much in different cases and under different circumstances. In general, it is very much heightened, especially when the hypertrophy is wholly physiological; on the other hand, it is occasionally greatly diminished: and instances are often observed where it is apparently quite natural. The consistence may likewise be normal, diminished, or increased. These three conditions do not, however, occur with equal frequency. An increase of density is by far the most common, and is particularly conspicuous in hypertrophy of the heart, mammary gland, the muscular fibres of the stomach and colon, the lymphatic ganglions, cellular tissue, bones, liver, spleen, and kidneys. A diminution of consistence is extremely rare, and cannot be viewed as a necessary consequence of the lesion.

An increase of weight of the affected organ follows, as a necessary consequence, in all cases where the lesion is not conjoined with atrophy. An augmentation of volume is by no means constant. Thus, in hypertrophy of the heart and bladder, there may be great development of the muscular fibres, with marked diminution of the size of their cavities. A change of form always arises when the hypertrophy is partially circumscribed, or limited to a particular point, as in the bones, skin, heart, bronchial tubes, and blood-vessels.

Hypertrophy essentially consists in an augmentation of the nutritive function. When in a state of unusual activity, the quantity of blood which an organ receives is considerably increased, in consequence of which it assumes a deeper color than one that is less exercised, at the same time that it augments somewhat in density; its elemetary particles are increased in number, or such as already exist are augmented in size. It is in this manner that the alteration under consideration is brought about. In that variety of it which results from chronic irritation, it is not unlikely that there is often superadded to the alteration just mentioned a deposit of new substance in the spaces of the connecting cellular tissue, leading thus to a real change of structure. The effects of hypertrophy on surrounding parts will be pointed out in connection with the different organs and textures of the body.

In regard to the treatment of hypertrophy, no definite rules can be laid down, as it must be regulated, in great degree, by the nature of the exciting cause, which should, therefore, always be a prominent object of inquiry.

Much benefit may, in general, be anticipated from the steady and persistent use of sorbefacients, locally and constitutionally applied, such as iodine, blisters, compression, mercury, iodide of potassium, and tartrate of antimony and potassa, aided by purgatives and attention to diet. In some cases, nothing short of the removal, partial or complete, of the affected organ will hold out any prospect of relief.

SECT. V.—ATROPHY.

Atrophy is the reverse of hypertrophy, consisting in a wasting of the substance of an organ, with a diminution of its weight and bulk. Occurring at all periods of life and in both sexes, it may affect a whole organ, or it may be limited to a part of an organ, or to some of its constituent elements.

Remarkable examples of general atrophy are occasionally met with, but such an occurrence is of no special surgical interest, and does not therefore demand any particular notice here. Cases of this kind are sometimes apparently of a congenital character; at other times they are the result of disease, and are either curable or otherwise, according to their extent and the nature of their exciting causes.

Local atrophy may be produced by a variety of causes, of which the principal are, first, cessation of the natural function of an organ; secondly, loss of nervous influence; thirdly, deficient supply of blood or nutritive matter; and lastly, inflammatory irritation.

It appears to be a law of the animal economy that an organ, when of no further use, gradually falls into a state of decay. Of this class of structures are the umbilical vesicle and the pupillary membrane of the fœtus, the former of which, after having subserved the purpose of its formation, disappears at the close of the third month, the latter between the seventh and eighth. The kidneys are preceded in the embryo by two jelly-like bodies, to which the term Wolffian has been applied; these bodies, which exist not only in the mammalia, but likewise in birds and amphibia, acquire their greatest bulk about the middle of utero-gestation, after which they gradually diminish by absorption, and at length entirely disappear. The gubernaculum, which is visible in the tenth week of embryotic life, is a thin membranous process, which guides the testicle to the internal ring, and is finally converted into cellular substance. These are instances of atrophy from the cessation of the functions of an organ in the fœtus. After birth changes not less remarkable are to be observed; such, for example, as the wasting of the thyroid body, the supra-renal capsules, and the thymus gland. From the same cause the alveolar processes of the jaws disappear after the removal of the teeth. The ovaries shrink after the decline of the menses; and, in conformity with a similar law, the testicles often diminish remarkably in size in monks, who lead a life of celibacy, in the strict observance of their vows.

Atrophy may result, secondly, from a diminution of nervous influence; a circumstance not surprising when it is recollected how much the action of the capillaries is under the control of the cerebro-spinal axis. Whole limbs sometimes waste from this cause; in other cases the lesion is more limited, and implies a very partial disorder of the nerves. It has been observed that atrophy, when caused by disease of the brain, occurs much more slowly than when it is occasioned by an affection of the nerves of the part. The reason of this difference is not very obvious.

This variety of atrophy is very common in young children during dentition, from the sudden and often total suspension of the nervous influence, constituting a species of local paralysis, which often terminates in complete wasting of the affected parts. It is most frequently observed in the lower extremities, sometimes in one, and at other times in both; but it also occurs, though much less frequently, in the upper extremities, particularly in the deltoid muscle, which is occasionally transformed into a pale, flabby, membranous layer, not more than a few lines in thickness.

Remarkable examples of atrophy of the upper extremities occasionally occur from pressure of the head of the humerus on the axillary plexus of nerves, thereby interrupting the nervous influx. When such an accident takes place in very young subjects, and is permitted to remain unrelieved, the growth of the limb, if not positively arrested, is imperfectly executed, and the consequence is that not only the muscles, but even the bones become singularly stunted in their development, their shafts being very thin, and their muscular prominences unnaturally small and indistinct.

It is probable that a mere perversion of the nervous function of an organ is capable of producing atrophy. In neuralgia of the testicle, that organ is sometimes remarkably diminished both in size and consistence, not so much, apparently, from an actual loss of nervous influx, as from a change in its character. What corroborates this view is the fact that the testicle, while the wasting process is in operation, is often so exquisitely sensitive as to be intolerant of the slightest manipulation.

The effects of a deficient supply of blood in producing atrophy are well known, inasmuch as cases of this description are sufficiently frequent in practice to make them an object of special interest. When any part is deprived of the usual quantity of this fluid, it very soon becomes enfeebled, its substance is rendered pale and flabby, and it at last loses the power of action, although every other condition for its performance may remain unimpaired. Thus, the testicle wastes after tying the spermatic artery; and, for the same reason, the muscles of the lower extremity occasionally shrink after securing the principal vascular trunk of the thigh. Atrophy of the heart is sometimes produced by ossification of the coronary vessels, and a case is recorded in which the spleen, from the obstructed condition of its artery, was not larger than a filbert. In old age, many of the capillaries are obliterated; and it is not improbable that to this circumstance is owing that diminution of the size of the organs which constitutes senile atrophy. To the same cause is to be attributed the wasting of the lung and heart, from the accumulation of fluids in the pleuritic and pericardiac cavities.

Atrophy attendant upon mere want of exercise is no doubt essentially due to deficient nervous and vascular supply; in conformity with the law, mentioned under the head of hypertrophy, that the development of an organ is usually in proportion to the amount of its use. The wasted and attenuated condition of the legs in club-foot and other affections depriving the muscles of their functions, or interfering with their proper exercise, is probably owing entirely to this cause, as is shown by the fact that, when the disability is removed, the individual gradually recovers the use of his limbs, the calves often becoming strong and plump, as if there never had been any arrest of growth. The only or chief, exception to this is where the muscles have undergone the fatty degeneration, in which case they never regain their original development, but always remain weak and puny.

Atrophy from inflammation is very common. A good example of this species of wasting is seen in what occurs in the gall-bladder from the presence of biliary concretions, and which is sometimes followed by complete wasting of this organ, its coats being converted into a thin fibrous mass, having hardly any trace of the original reservoir. Hepatitis often gives rise to atrophy of the parenchymatous structure of the liver, and orchitis, especially when supervening on mumps, is not unfrequently succeeded by impotence. How the lesion, in these and other cases, is produced, is not easily determined. It is probable that the inflammatory deposits may so choke up the capillary vessels of the parts as to deprive them of their customary and necessary supply of nutritive material; or, if this conjecture be untenable, that the pressure exerted by these effusions causes the absorption of some of the anatomical elements of the affected structures, thus reducing them, as it were, to their primitive condition.

Atrophied structures are prone to undergo the fatty transformation, and it is not improbable that this transformation itself occasionally acts as an exciting cause of the wasting process. However this may be, it is certain that the two lesions are sometimes so intimately associated as to render it impossible to determine which preceded the other, or what part they played as cause and effect.

The change of color experienced by an atrophied organ is necessarily greatly influenced by the natural complexion of the part, but does not possess any special surgical interest. The weight of the affected structures is generally considerably diminished, but their bulk often remains unaltered, and it is not uncommon to meet with cases where it is even greater than natural.

The treatment of atrophy, occurring in an external or accessible part of the body, as a muscle, resolves itself into the use of the warm and cold douche, frictions, either dry or through the medium of stimulating embrocations, and the application of electricity, as described under the head of wasting palsy. The general health must be amended, strychnine and tonics being given when there is marked evidence of debility. The affected part must be gradually and steadily exercised, or, as it were, re-educated; the influence of a strong will frequently directed upon it being often of essential service in rousing its latent faculties.

SECT. VI.—CONTRACTION AND OBLITERATION.

By the term contraction is meant the diminution of a canal, tube, or passage to an extent incompatible with the due performance of its functions. It is strictly synonymous with the term stricture, the signification of which is so well understood by the surgeon. The lesion is liable to occur in various degrees, from the slightest possible change in the size of a canal to the complete obliteration of its caliber.

The chief interest of this subject, surgically considered, relates to the contractions that occur in the mucous canals, or excretory ducts, as they are called, and in the bloodvessels, in both of which the lesion is frequently productive of the most disastrous consequences; attended, in the former, by retention of the secretions of these tubes and of the contents of the reservoirs with which they communicate, and in the latter by an impediment to the circulation which, in one case, may lead to atrophy, and, in another, to softening, ulceration, or gangrene.

Contractions of the mucous passages, to which the ensuing remarks are more particularly designed to apply, are deserving of great attention, both from the frequency of their occurrence, and from the great suffering which they so often entail upon those who are the subjects of them. They are met with in nearly every mucous outlet of the body, but are more common in the male urethra and in the nasal canal than anywhere else. Doubtless stricture often exists in the smaller excretory ducts, as those of the prostate and salivary glands, without our knowledge, or without awakening any serious functional disturbance; but in the larger passages the slightest coarctation is generally a source of more or less annoyance, if not of great pain and inconvenience.

The causes under whose influence contraction takes place are mainly two;

part, organ, canal, or cavity affected. The disease, which is always of a consecutive nature, occurs in different regions of the body, and is developed under the influence of various causes.

Although the abnormal track has usually two openings, one of which is superficial and the other deep-seated, yet this is by no means constantly the case. Hence the distinction of fistules into complete and partial. The terms recent and old, often used by writers, refer merely to the duration of the disease.

The lesion may occur in almost any situation, but originates most frequently about the anus, perineum, face, groin, and mammary gland. Fistule of the neck, thoracic cavity, the biliary apparatus, the stomach, colon, and small bowel, kidney, pancreas, and urinary bladder, is comparatively rare. It takes place in both sexes and at every period of life; but children and young persons suffer much less frequently than the old and middle-aged.

The nomenclature of fistule is quite extensive. The names are derived either from the parts in which the abnormal passage is situated, as anal, perineal, broncho-pleural, and recto-vaginal, or from the nature of the discharge, as salivary, urinary, and stercoraceous.

Fistules vary much in their extent. The longest tracks occur along the spinal column in connection with psoas abscess. In this affection, the matter generally escapes in the groin, just above Poupart's ligament, in the upper part of the thigh, or, lastly, in the ileo-lumbar region, the channel which is thus established varying in length from six to twelve inches, and being always lined by a well-organized, adventitious membrane. Passages of considerable length are sometimes met with in the internal organs, as between the kidney and lung, between one coil of intestine and another, or between the urinary bladder and the cutaneous surface. In other situations, on the contrary, the track is remarkably short, being hardly two or three lines from the surface, or from the cavity with which it communicates.

The diameter of these abnormal tracks is also very variable. Sometimes they are so small as scarcely to admit the finest bristle; while at other times they are sufficiently capacious to receive a goose-quill or the end of the finger. The narrowest tracks usually occur in the lachrymal passages, salivary glands, anus, and perineum. It is not often that the fistule is of the same uniform diameter throughout; on the contrary, it is almost always larger at one point than at another.

The external orifice, generally of a rounded or oval shape, may be so narrow, on the one hand, as to be hardly perceptible, or, on the other, so large as to admit the end of a probe, a goose-quill, or a finger. It may have sharp and well-defined margins; be surrounded by a soft, spongy, florid rim; or, be depressed, inverted, or infundibuliform. The number of external orifices varies in different cases, from one to as many as six or a dozen; when it is very considerable, the affected surface commonly presents a cribriform appearance.

The internal orifice may be of the same size as the external, or it may be smaller or larger. In its shape it is usually irregularly rounded, and it is seldom that it is found multiple, even when the number of external openings is considerable.

Although the direction of the passage may be perfectly straight, yet, in general, it is more or less flexuous, serpentine, oblique, or winding. Occasionally it forms nearly a right angle with the surface on which it opens. When several tracks exist, they often run together, and open by one common orifice upon the reservoir with which they communicate.

A fistule, in its recent state, is simply a raw surface, secreting purulent matter. It is, in fact, an ulcer, an open sore, a solution of continuity, which must undergo a process of reparation before it can be justly entitled to its distinctive appellation. The track, however, soon becomes smooth, and is speedily coated with an adventitious membrane, varying in thickness from a mere film to half a line, a line, or even the sixth of an inch. This new layer, at first soft and easily detached, gradually augments in density, and is at length inseparably united to the parts which it serves to line. Its color, like its consistence, is very much influenced by its age, and by the nature of the secretion or excretion which passes over it. At an early period it is red, pink, or rose; in cases of long standing, on the contrary, it is either white, gray, or slightly bluish. The free surface of the membrane is smooth and polished; or it is rough, mammillated, or studded with villi of various shapes and sizes. The other surface is attached by means of short cellular substance to the parts upon which it lies. Bands of lymph sometimes extend from one side of the abnormal channel to the other, very much as in the bridle stricture of the urethra; but this is rare.

The membrane here described is formed out of the plastic lymph of the blood, and is of the same nature as the pyogenic membrane of a chronic abscess. Around the anus, in the perineum, and in some other regions, it bears no little resemblance to the mucous tissue, but differs from it in having no follicles and no distinct epithelial layer. It is liberally supplied with vessels, nerves, and, probably, also with absorbents, is the seat of a constant secretion of gleety or other matter, and is liable, like all new textures, to inflammation and its consequences. In ancient cases it occasionally acquires a dense, fibrous, or fibro-cartilaginous consistence.

The nature of the discharge in this disease varies with the situation of the abnormal passage. In general, it is thin and gleety, as in chronic gonorrhœa, and mingled with the natural secretions, or excretions of the reservoir with which the fistule communicates. When, however, the lining membrane labors under inflammatory irritation, the discharge is either entirely suspended, or it is bloody, purulent, or muco-purulent.

The parts in which the abnormal track is situated are variously affected. In some cases they are nearly natural; but in general they are firm and callous, from the effusion and organization of plastic lymph, which, being often present in large quantity, completely obliterates the meshes of the connecting cellular tissue.

Finally, the causes which give rise to fistules are either mechanical or vital. To the first class belong wounds, contusions, and lacerations; to the second, ulceration, gangrene, and abscesses. There is a variety of fistule which may be regarded as a remnant of embryotic organization. Its most frequent situation is the antero-lateral part of the neck. Like the ordinary fistule, it may terminate in a cul-de-sac, or it may have two orifices, of which the external is sometimes scarcely visible. The abnormal passage itself is usually very narrow, and seldom extends beyond two or three lines in depth.

The *treatment* of fistule must be regulated by circumstances. In recent cases, before the passage has become lined by an adventitious membrane, a cure will somtimes follow the use of stimulating injections, as a weak solution of nitrate of silver, sulphate of copper, tincture of iodine, or acetate of lead, repeated twice in the twenty-four hours; or by touching the parts lightly once a day, or once every other day, with the solid lunar caustic, or with the end of a probe dipped in a solution of the acid nitrate of mercury. Strict attention should be paid to cleanliness, and the parts should be maintained in a state of absolute rest. It is seldom, however, that a permanent cure can be effected in this way, especially if the fistule be of any extent, or situated where it is influenced by the contraction of muscular fibres, as, for example, when it involves the anus. The best plan, in fact, nearly always, is not to lose any time in experimenting with these remedies, but at once to lay open the abnormal passage in its entire length, so as to afford the parts an opportunity of healing from the bottom by the granulating process, a tent being interposed between the edges to prevent their readhesion. Occasionally a seton may be passed through the track, and be retained until it ulcerates out. In some forms of fistule, as in the vesico-vaginal and urethral, a very delicate operation is generally required in order to effect a cure, consisting in paring the margins of the opening and bringing them together by several points of suture.

The healing of a fistule is often materially retarded, if not effectually prevented, by the presence of a foreign body, as a mass of dead cellular tissue, a loose piece of bone, a bullet, or a portion of wadding, or, by the contact of some irritating fluid, as the urine, or of fecal matter. The indication, of course, is to remove the extraneous substance whatever it may be, and then to manage the case upon the principles just laid down.

Occasionally, again, the difficulty in respect to a cure may depend, at least in part, upon deficient tone of the system, or some disorder of the general health. The patient, for example, may be anemic from organic disease, intemperance, or want of wholesome air and food. Such cases are not uncommon in large cities and in the wards of crowded, ill-ventilated hospitals, and readily suggest their own treatment.

The prudent practitioner is sometimes sorely perplexed in this disease as to the propriety of attempting a radical cure, or whether he should interfere only so far as to palliate the patient's suffering. In general, it will be best to let each case be governed by its own rules. When the fistule has been of long standing, and has acted all along as a drain upon the system, serving perhaps to counteract some other affection, such as phthisis or a tendency to apoplexy, no operation should be practised, since it could hardly fail to provoke mischief. In fact, serious organic disease of any kind is a contra-indication to an operation. The only exception to this is where the fistule is a cause of excessive local distress, completely depriving the patient for days of sleep, appetite, and comfort. Under such circumstances the surgeon could hardly refuse his aid; but before doing this, he would be sure to open a new source of counter-irritation, in the form of an issue or seton, in some other and more eligible portion of the body, thus establishing a drain at least equal to that which he is about to suppress in order to afford temporary mitigation. In ordinary cases there is of course no reason for delay; the operation is promptly performed, and a rapid recovery is reasonably anticipated.

may, at the age of puberty, be less than that of a child at the eighth or tenth year.

2dly. A congenital *redundancy* of structures is sometimes met with, consisting, chiefly, in hypertrophy of the integuments of various regions of the body, or in the addition of a supernumerary finger, toe, tooth, or ear. To the same category belong the anomalous divisions of certain arteries, as the brachial and femoral, high up in their respective limbs. A redundancy of skin and cellular substance is most common about the neck, hands, feet, and genital organs, as the prepuce and vulva, where the superfluous structures sometimes occur in large, pendulous masses. A supernumerary toe, thumb, or finger is no unusual occurrence; occasionally each hand and each foot are provided with such an appendage. I have seen one well-marked case of four ears; an increase of the natural number of teeth is not uncommon. In some of these cases the supernumerary organ is buried in the alveolar process of the jaw, where I have known it to be productive of such an amount of disease as to require a serious operation for its removal. Most of these malformations admit of cure by retrenchment with the knife, and the operation may generally be safely executed at an early age.

3dly. Congenital *displacements* occur in various parts of the body, but principally in the articulations and in the abdominal viscera. The joints that are most liable to this form of dislocation are the hip, shoulder, and wrist; but it has also, although very seldom, been met with in those of the jaw, clavicle, elbow, and knee. The deformity thus produced is often very great, and what aggravates the case is the circumstance that it rarely admits of relief, however skilfully and perseveringly it may be treated. The malformation, as will be shown elsewhere, probably begins at an early period of fœtal life, and goes on gradually increasing until it attains an irremediable stage.

The most common form of displacement of the abdominal viscera occurs in what is called congenital hernia, caused by a want of closure of the inguinal canal during the descent of the testis. The consequence is that, soon after the child has begun to breathe, the diaphragm, pressing the bowels against the walls of the abdomen, forces them down into the scrotum. The portion of tube thus displaced is generally a loop of small intestine, but now and then other organs are pushed down along with it. The most suitable remedy for such a defect is steady compression upon the neck of the hernia by means of a well-adjusted truss, which generally eventuates in an effusion of lymph, and the obliteration of the sac of the tumor.

4thly. Congenital *occlusion* may occur in any of the mucous outlets of the body, but is much more frequent at the anus and genital organs than anywhere else. Closure, properly so called, of the anus may be produced by a continuation of the integuments across from one buttock to the other; or it may depend upon the existence of a fold of mucous membrane situated just within the anus, an arrangement not unlike a hymen. In either case, relief may easily be effected by the knife, patency being afterwards maintained by the frequent insertion of the finger. The prepuce is sometimes completely impervious, or if an opening be present, it answers very imperfectly the purpose of an outlet for the urine. The vagina is occasionally imperforate, being closed by what is termed the hymen; and there is reason to believe that certain forms of sterility are due to occlusion of the uterus, or of the Fallopian tubes.

5thly. Congenital *deviations* of position are infrequent. The most interesting, in a surgical point of view, is the deformity of the nasal septum, which is sometimes so great as to interfere materially with the functions of the nose, one of the anterior nares being sometimes completely occluded by the projection of the partition towards the corresponding side. A simple operation, consisting in the removal of the incurvated portion of the septum, generally effectually relieves the difficulty.

There is occasionally a remarkable congenital incurvation of the penis, disqualifying the organ for the easy and full discharge of its functions. The defect is always associated with hypospadias, and consequent shortening, or imperfect development of the spongy structure of the urethra. An admirable operation for the cure of this deformity, devised by my colleague, Professor Pancoast, will be described in the chapter on the genital organs.

Deviation of position is often associated with permanent contraction or shortening of the muscles and tendons, as is seen in club-foot, wry-neck, and other analogous distortions. This class of lesions is one of great practical interest, having opened to the modern practitioner a wide field for the exercise of his ingenuity and skill, as well as of his patience. Taken in hand soon after birth, they may frequently be promptly remedied by the use of the most simple appliances, whereas under opposite circumstances the treatment will generally be very tedious, even if aided by the free division of the affected structures. The rectification of these malformations forms one of the most interesting chapters in the history of subcutaneous surgery, one of the great discoveries of modern times.

6thly. Congenital *adhesions* are sometimes observed, chiefly between the fingers and toes; more rarely between other parts, as the eyelids and the ball of the eye, the ear and the scalp. The uniting medium is generally merely a fold of common integument, the severance of which often effectually releases the parts from their restraint, and restores them to usefulness.

7thly. I may mention, finally, as another class of congenital affections, those peculiar vascular tumors known as *nevi*, or *mother's marks;* they occur in different regions of the body, especially the head and face, and constitute an exceedingly interesting and important form of morbid growth. Their composition is variable; sometimes they are essentially composed of dilated and tortuous capillary veins, connected by areolar tissue; at other times they are made up mainly of enlarged and diseased capillary arteries; lastly, there is a third species which seems to partake of the character of both the others, the two sets of vessels being so intimately blended as to render it impossible to determine which predominates.

These vascular growths, however constituted, almost always begin in the substance of the skin, from which, as they augment in size, they gradually extend to the cellular tissue beneath; they are of a soft, spongy consistence, readily receding under pressure, and expanding under mental emotion. Their color is variable; the venous varieties being usually of a dark purple, and the arterial of a red scarlet hue. The latter are of a truly erectile character, and hence they commonly pulsate, heaving and throbbing synchronously with the contraction of the left ventricle of the heart. The growth of both varieties is generally steadily progressive, and the consequence is that they often acquire a considerable bulk.

Most of these morbid growths readily admit of cure, especially if timeously begun. This may be effected, 1st, by ligation; 2dly, by excision; and 3dly, by escharotics.

In regard to the causes of these various malformations, it would be entirely out of place to inquire into them here. My sole object has been to bring the subject briefly before the reader in its practical relations; any other information respecting it may readily be obtained by a reference to the many works specially devoted to such discussions. Some of these malformations are doubtless owing to an arrest of development, dependent upon a defective organization of the germ; others are probably caused by irritation of the nervous centres; while others, again, are perhaps due to faulty position of the fœtus in the uterus, or violence inflicted upon it during gestation.

CHAPTER VII.

TUMORS, OR MORBID GROWTHS.

SECT. I.—GENERAL OBSERVATIONS.

WHAT is a tumor? The best definition that, in my judgment, can be given of it is that it is an enlargement of a part, structure, or organ, produced by abnormal deposit. This abnormal deposit may be an entirely new formation, or it may be merely a superaddition to the original one. It may, moreover, be benign or malignant; that is, it may simply incommodate by its situation, weight, and bulk, or it may, after a certain period, destroy not only the part in which it appears, but also the patient. It may be stated, as a general law, that most of the benign tumors, or innocuous growths, are the result merely of some alteration in the function of the primitive tissues; many, indeed, are nothing but local hypertrophies, or enlargements produced by inflammatory deposits, supernutrition, or the retention of some normal secretion. On the other hand, malignant tumors are always caused by the deposit of a new substance which is either entirely distinct from the natural structures, or which bears but a very faint resemblance to them, in its physical, chemical, and vital relations. The only exception, perhaps, to this law is the hydatic tumor, which, although it is altogether foreign to the natural organization, is of a non-malignant character.

The number of malignant formations, so far as is at present known, is comparatively small, while the number of benign is very considerable. Occurring at nearly all periods of life, and in nearly all the organs and tissues of the body, they possess certain features in common with each other, which renders it necessary to study them in a general point of view. Such a proceeding is indispensable to a correct appreciation of the structure, diagnosis, and treatment of these affections. The principal topics to be considered, in connection with these circumstances, are, first, the physical properties of the morbid growth; secondly, its relations to the surrounding structures; and thirdly, its history.

1st. It would be difficult to point out a *situation* where tumors may not occur. With the exception of the tendons, fibrous membranes, cartilages, and bloodvessels, they are found in all parts of the body, and it would hardly be proper to affirm that even these structures are altogether exempt from them. As a general rule, it may be stated that malignant growths are most common in glandular organs, as the mamma, liver, and mucous follicles; in the cellulo-adipose tissue, as in the case of melanosis; or in the peritoneum, stomach, bowel, and bones, as in that of colloid. Tubercular deposits occur almost everywhere; but, surgically considered, more frequently in the lymphatic glands than anywhere else. Epithelial cancer has a peculiar predilection for the cutaneous and mucous textures at the various outlets of the body. Benign tumors are most common in the skin, cellulo-adipose tissue, nose, uterus, and ovary. Hydatic formations are seen chiefly in the liver, breast, testicle, and bones.

Tumors affect various *forms*, depending not merely upon the nature and amount of resistance offered to their development, but also, in some degree, upon the original shape of the part wherein they originate. A sebaceous tumor is generally globular; a fatty one either flat or pendulous; a polypoid one pyriform, conical, or pediculated. Malignant growths are commonly distinguished by the irregularity of their surface, which is often lobulated, or marked off into ridges and depressions.

In their *volume*, tumors range, in every possible gradation, from that of a millet-seed, as in the little granule on the eyelid, to that of the patient's body, as in ovarian cysts and elephantiasis of the scrotum, those enormous masses which are sometimes absolutely more bulky and heavy than the subject in whom they are developed. Fatty, fibrous, and osseous growths occasionally acquire a large size, but they are almost the only ones of their class that do. Among the heterologous tumors, those which attain the greatest magnitude are the encephaloid and colloid; scirrhous, melanotic, and other formations of this description, being usually comparatively small.

In respect to their *consistence*, some tumors are soft, some solid, some semisolid. Tumors containing serous fluid, as hygromatous cysts of the neck and of the ovary, are always soft and fluctuating, unless they are overlaid by a large quantity of solid substance, when they may partake of the latter character even more than of the former. Fibrous and osseous tumors are known by their great hardness, which is equal to that of the natural structures. Scirrhus is the most firm of the heteroclite tumors, its name being derived from that circumstance. Occasionally one portion of a tumor is soft, another hard, and a third, perhaps, semi-liquid. Ovarian growths exhibit these varieties of consistence more frequently, and in a more perplexing degree, than any other, whether benign or malignant.

The *color* of a tumor is generally a matter of secondary consideration, as it is seldom that the morbid growth is sufficiently exposed to admit of direct inspection, except in some of the mucous outlets. In the early stage of all formations of this kind that take place beneath the external surface of the body, there is usually an absence of discoloration, and it is only when the growth bears too heavily upon the skin, pushing it out in every direction, or when it manifests a disposition to ulcerate and evacuate its contents, that it causes the skin to be red, livid, or purple. In tumors of the nose, uterus, and anus, color often affords us great assistance in our discrimination of the case. A gelatinoid polyp can never be mistaken for a fibrous one, its complexion being always a diagnostic of its character. It may be assumed, as a general rule, that the lighter a tumor is externally the greater is the probability of its being benign, and conversely.

Mobility is an important quality in a tumor, its amount varying according to the nature of the affected organ and the degree of resistance offered by the surrounding parts. Some morbid growths are never movable, others always are, whatever may be their age, volume, or situation. A sebaceous tumor never contracts such firm adhesions as not to be susceptible of being pushed about; while an exostosis is always immovable from its very commencement. Most of these formations, whatever may be their character, contract adhesions to the surrounding tissues as they augment in age and volume, their pressure exciting inflammation and plastic deposits, which thus become the bond of union between the normal and abnormal structures.

Tumors are endowed with various degrees of *sensibility*, depending upon the peculiarity of their structure and the amount of compression exerted upon them by the parts in which they are developed. Most tumors, whether innocuous or malignant, are free from pain during their earlier stages; but, as they increase in size, they encroach upon the neighboring tissues in such a manner as to interfere with their movements, and thus seriously compress their nerves, whilst the latter, in their turn, more or less compress the nerves of the advancing mass. Occasionally the pain is characteristic, as, for example, in scirrhus of the mammary gland. Encysted tumors of the skin are usually entirely free from pain, or, if there be any pain, it is the result of accidental circumstances.

2dly. In regard to the *relations* which tumors bear to the surrounding structures, several circumstances deserve to be noticed. The first is the manner in which they are bound down, or inclosed in their habitation. Every tumor must necessarily have an appropriate residence, but, like a settler in a new country, it is seldom content with the spot originally assigned to it. On the contrary, soon lacking room, it is sure to encroach upon, fret, and worry the parts around it, which, as already seen, are not slow to resent the invasion. Mutual oppression and mutual discomfort are the result. The healthy structures successfully resist for a while the intrusion, but gradually they yield before the enlarging mass, which thus often converts the muscles into mere ribbons and the bones into mere shells. Function, too, may be seriously interfered with; the ranula filling the mouth, the goitre compressing the neck, and the polyp closing the womb.

In the second place, as the tumor progresses, it is apt, either by the continued pressure which it exerts upon the superimposed parts, or in consequence of the gradual decay of its own structure, to produce ulceration, followed by more or less discharge. This tendency, although most conspicuous in the heteroclite formations, is not peculiar to them, but is also witnessed in some of the benign growths, as the encysted and adipose. Large vessels are sometimes laid open during the progress of the disease, thereby inducing copious hemorrhage.

Tumors often occasion serious disease in the surrounding lymphatic ganglions. This is particularly true of malignant tumors, in some of which it forms a very conspicuous and almost unmistakable feature. In cancer of the jaw the ganglions of the neck enlarge; of the breast, the ganglions of the axilla; and of the testicle, the ganglions of the groin; either by actual extension of the morbid action, or from sympathetic irritation.

Finally, an intimate *sympathy* exists between tumors and the constitution, operating at one time beneficially, at another, prejudicially. The progress of malignant growths is often stayed for months and years, simply by attention to the general health; on the other hand, it is frequently astonishingly hastened by disorder of the system, and, in fact, by whatever has a tendency to produce derangement of the secretions, especially those of the liver, uterus, and kidneys.

3dly. The *history* of the case often furnishes important points of comparison. Tumors occur at all periods of life, in both sexes, in all classes of society, and in all varieties of temperament. Certain forms of malignant disease, however, are most common at one period, and others at another. Thus, scirrhus is almost peculiar to elderly subjects, while encephaloid is most frequent between the ages of twenty and fifty. The scrofulous tumor is most common in childhood and adolescence. Benign growths of every description are often observed in early life, but the greatest number of cases occur in young adults.

Rapidity of growth and great bulk imply inordinate vascular activity, and lead to a suspicion of malignancy. There is no tumor that attains so great a bulk in so short a time as the encephaloid, and certainly none that is more surely fatal. Ovarian cysts of the non-malignant type, often acquire an astonishing development in a comparatively brief space. Sebaceous, polypous, osseous, and fatty tumors, on the contrary, usually grow slowly, and occasionally even enjoy a period of repose.

Constitutional involvement may be occasioned by sheer malignancy, or by the injurious effects exerted by the morbid growth upon important structures in its neighborhood. In general, rapidity of development, large size, and early formation of adhesions, along with enlargement of the lymphatic ganglions, and constitutional disorder, may be regarded as evidences of a malignant tendency.

Certain tumors have a disposition to return after extirpation; others, on the contrary, never relapse. All malignant growths, without exception, possess this repullulating tendency, and hence their removal is rarely followed by a permanent cure. Relapse, however, may also occur when the tumor is perfectly benign, but then it is generally dependent upon imperfect extirpation. Thus, an encysted tumor will almost be certain to recur if a portion of its sac be left behind.

It is seldom that a tumor disappears spontaneously; nevertheless, such an occurrence is possible, and there are several ways in which it may be effected, as by absorption, enucleation, ulceration, and gangrene. The former of these modes of cure is the most common; one of the best examples of it occurs in the scrofulous tumor, so frequently met with in the neck and about the angle of the jaw in strumous children, from exposure to cold and derangement of the digestive organs. The disease essentially consists in an inflammatory enlargement of one or more lymphatic ganglions, which after having existed perhaps for years, finally goes away without any assignable cause, merely, to all appearance, in consequence of an improved state of the general health, and of a change in the nutrition of the part.

Sometimes a tumor becomes enucleated, and drops off, leaving perhaps merely its inclosing cyst. It is thus that the fibrous tumor of the uterus is occasionally detached; and the same thing may happen to an exostosis, particularly if it be large and situated upon the skull. In such cases the vascular connection between the morbid growth and the circumjacent structures is probably, as a preliminary step, in a great degree destroyed, so that the tumor, gradually dying and acting as a foreign body, is at length cast off by the living tissues.

A cure is occasionally effected by profuse suppuration, or, more correctly speaking, by suppuration and ulceration. The kind of tumor most easily influenced in this way is the scrofulous, which is either completely disintegrated and broken down, or it is dissected off by ulcerative action, and is finally detached as an effete substance.

Lastly, gangrene seizing upon a tumor may so interfere with its circulation as effectually to destroy its vitality. Such an occurrence, although very rare, may take place in a malignant as well as in a benign growth. Some years ago, I attended an elderly lady on account of scirrhus of the mammary gland; after the disease had been going on for upwards of a year, the carcinomatous structures were suddenly attacked by gangrene, and in less than a week they dropped off in the form of a black slough, leaving in their stead a large excavated cavity.

SECT. II.—BENIGN TUMORS.

The benign or non-malignant tumors may be arranged under the following heads: 1. Hypertrophic; 2, vascular; 3, adipose; 4, horny; 5, fibrous; 6, cartilaginous; 7, osseous; 8, calcareous; 9, neuromatous; 10, cystic; 11. hydatic; 12, polypoid; and 13, myeloid. The latter, however, must, for the present, occupy an equivocal position in this arrangement. As for myself, I have very little doubt but that it will ultimately be found to be merely a variety of encephaloid.

1. HYPERTROPHIC TUMORS.

I employ the term "hypertrophic" to designate a class of tumors which are produced by the gradual enlargement of an organ, in consequence of an increase of its nutrition. A good type of this form of tumor occurs in the thyroid body, in what is generally known as goitre. This affection, which commonly begins very early in life, consists essentially in an abnormal development of the component elements of the gland, simply as the result of a preternatural supply of blood. What the immediate cause of this increased supply is does not admit of easy explanation. It is possible, although problematical, that it may originally depend upon inflammatory irritation; but, even if this be true, it can hardly be supposed that this action would continue through a series of twenty, thirty, and even fifty years, as we know it often does, from the steady and persistent increase of the morbid mass. Whatever, therefore, may set the process in motion must, after a time, cease to exert its influence, while the perverted movement, once begun, daily progresses, until the structures affected by it are incapable of further change. This idea derives additional support from the fact that goitre, after having attained a certain degree of development, often remains stationary for a long period, when, perhaps suddenly and without any obvious cause, it again commences to grow. If such a tumor be examined in its earlier stages, it will be found that, while the tissues are unnaturally red, firm, and distinct, and that, while the thyroid arteries which supply them with blood are unnaturally voluminous, there is no evidence whatever of plastic deposits justifying the belief that inflammation had any agency in the production of these changes. If, at a later period in the disease, we find various morbid products, such as the pathologist is accustomed to regard as the consequence of inflammation, it only shows that they are the result of secondary causes, developed during the progress of the hypertrophy, which is itself, no doubt, often a source of inflammation to the affected tissues.

Hypertrophy of the prostate gland, generally described as senile enlargement, is often produced in a similar way. The same cause usually presides over the development of those enormous growths of the mamma which are occasionally observed in young females, in which that organ has been known to acquire a bulk many times exceeding the natural one. Congenital enlargement of the tongue affords another well-marked example of the same mode of formation.

A chronically enlarged tonsil is another specimen of this form of tumor, only that the hypertrophy is usually attended with an inordinate amount of plastic deposit. The inflammation, however, after a time, frequently disappears; but not so the enlargement. On the contrary, when it has once been fairly established, it often steadily progresses until the gland has attained an enormous bulk, simply in consequence of the increased nutrition of its proper tissues, aided by occasional subsequent attacks of inflammation, to which the parts are always remarkably prone after having once been assailed by this disease.

The encysted tumor of the skin, the common sebaceous tumor of authors, is essentially a hypertrophic formation, awakened by obstruction of the outlet of a skin follicle, caused either by inflammation or by the impaction of sebaceous matter. The natural secretion being thus retained, presses upon the walls of the follicle in every direction, thus inviting a preternatural afflux of blood, probably attended, in the first instance, by interstitial deposits, but gradually subsiding as the cyst becomes tolerant of the presence of the altered and now foreign substance. That this is true does not admit of doubt, especially if we reflect upon the fact that this form of tumor often steadily increases for many years without any demonstrable evidence of inflammatory irritation.

To the same category as the above affections belong those chronic lesions of the lymphatic ganglions in which there is not only more or less augmentation of their volume, but marked induration and alteration of their proper tissue. Sometimes a large tumor is formed in this way by a single gland, but, in general, such growths consist of an agglomeration of several bodies of this kind, united so as to form a bulky mass, of a nodulated character, and of extraordinary firmness.

If we adopt the term which I have here employed to designate these changes, we shall be able to dispense altogether with the word "sarcoma," introduced by Mr. Abernethy, and so constantly used since his time, in reference to certain alterations produced in our organs as a consequence either of simple supernutrition or inflammatory deposits, or both conjoined. Sarcoma literally signifies flesh, and is therefore wholly inapplicable, not only to this but also to every other form of morbid growth, which never has any resemblance, not even the faintest, to flesh. The sarcomatous testicle, for example, as it was formerly called, in conformity with the nomenclature of the English surgeon, is merely a chronic enlargement of that organ, the result of inflammatory deposits and supernutrition of its proper structures.

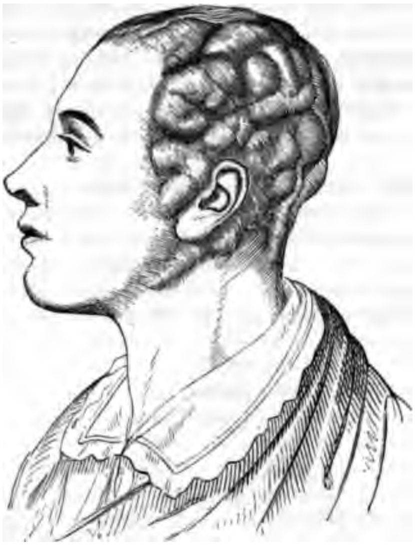
The mammary gland not unfrequently enlarges in a similar manner, its substance being indurated and distinctly defined, but not so completely masked as to lose all trace of its primitive character. The organ is simply hypertrophied, and is therefore capable, under judicious management, of regaining its natural properties.

Much is to be expected from medical treatment in this class of tumors. The remedies upon which our chief reliance is to be placed are purgatives and sorbefacients, with strict attention to the diet. Occasionally, valuable aid is derived from topical bleeding, especially when there is decided evidence of overaction with tendency to plastic effusion from inflammatory accession. The bowels having been duly attended to, the best internal remedies are, in the more recent cases, the milder forms of mercury, and, in the more chronic, the different preparations of iodine, of which Lugol's solution and the iodide of potassium are entitled to preference. The object is to change capillary action and to promote absorption of redundant material, whether the product merely of simple or of perverted nutrition. The action of internal remedies is generally very much increased, under such circumstances, by local applications, employed so as to excite the secernents without irritating the skin. They may consist of unguents, embrocations, or liniments, used several times in the twenty-four hours, their beneficial effects being aided by rest and other means calculated to favor restoration of structure and function. Blistering occasionally exerts a most powerful influence in affording relief. Cutting off the supply of blood to the part by tying the main artery leading to it has sometimes been successfully practised. Excision is performed only as a dernier resort; partial, as in the case of an enlarged tonsil, complete, as when the mammary gland or a lymphatic ganglion is involved.

2. VASCULAR TUMORS.

The vascular tumor, of which a good idea may be formed by reference to fig. 25, essentially consists, as the name implies, of a network of small blood-vessels, connected together by areolar substance. It is generally met with as a congenital affection, its foundation being laid during fœtal life, and it is not uncommon for it to acquire a considerable bulk before birth. Most generally, however, it is quite diminutive when the child is born, and it often continues so until some time after, when, perhaps, all of a sudden, and without any assignable cause, it takes a new start, growing with remarkable rapidity. The ordinary sites of the vascular tumor are the head, face, and mucous membranes, especially that of the rectum, where it often presents itself in the form of what is called an internal pile. Their color ranges from a deep rose to scarlet or purple. They are of a soft, spongy consistence, and vary in size from that of a mustard seed to that of a fœtal head.

Fig. 25.



Vascular tumor of the scalp.

The vascular tumor exhibits considerable variety of structure; being sometimes essentially composed of veins, sometimes of arteries, and sometimes, again, of both arteries and veins together, so equally balanced, in number and caliber, as to render it difficult to determine which predominate. When the tumor is of an arterial character it generally pulsates synchronously with the left ventricle of the heart, and constitutes a real erectile growth, similar to that of the cavernous body of the penis. As these formations will claim special attention in the chapter on the diseases of the vascular system, no further notice of them will here be necessary.

3. FATTY TUMORS.

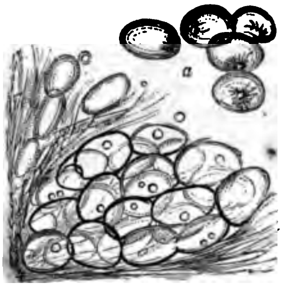
The fatty tumor is quite common. It may occur in any part of the body, with the exception, perhaps, of the palm of the hand, the sole of the foot, fingers, and toes. It is seen, however, more frequently about the back, shoulder, and neck, than in any other regions. The upper eyelid is also a common seat of it. Sometimes, but more rarely, it occurs in the orbit of the eye, in the walls of the abdomen, in the perineum, the labium, and underneath the tongue, and even in the substance of this organ. Large masses of this kind occasionally form in the internal cavities of the body, as in the omentum and mesentery, and around the kidneys.

The number of fatty tumors varies, in different cases, from one to several hundred. In general, they are solitary, or, at most, there are only two or three, occupying different regions of the body, or grouped more or less closely together. In a medical gentleman, aged thirty-eight, who attended my lectures some years ago, I counted upwards of two hundred, from the volume of a small pea up to that of a large marble. They all had a doughy, inelastic feel, and most of them were of a globular shape; a few were slightly flattened, or compressed. They were situated principally on the forearms, the inside of the thighs, the loins, abdomen, and pectoral muscles, the latter of which were literally covered with them. None existed on the head, neck, and upper part of the back. The general health was good, and the tumors had been first observed about sixteen years previously. During two severe attacks of acute disease, accompanied with great emaciation, many which dip into the interior of the morbid growth, separating it into lobes, lobules, and granules, until the component tissues are resolved into their ultimate elements. These processes are usually very delicate; but occasionally, as when there is a hypertrophous condition of the fibro-cellular substance, they are quite dense and tough, forming distinct bands, of a whitish or grayish color, between the different structures.

Fatty tumors do not receive much blood, at least not as a general rule; hence they seldom bleed much when they are extirpated. It is only when they are of large size, or when they grow very rapidly, that they are likely to be very vascular. The capsule and its processes serve to conduct the vessels into the interior of the tumor, and to direct, as it were, the distribution of their branches and ramifications. As the morbid mass is always free from pain, and is tolerant of the rudest manipulation, it may be concluded that it receives very few nerves. Its absorbent vessels are also few in number. It may, furthermore, be inferred that, inasmuch as the general health is usually unimpaired throughout the whole progress of the affection, however long it may continue, it does not possess any important sympathetic relations with the general economy.

The minute structure of this form of tumor is well displayed in fig. 27. It is made up of cells, exactly similar to those of natural fat, interspersed through areolar tissue, as seen in the larger drawing; the small figure *a* represents isolated cells, showing the crystalline nucleus of margaric acid. Various other substances, of an adventitious character, generally present themselves upon the field of the microscope, in the form of molecules, granules, and globules, especially in old fatty growths. It is upon these accidental occurrences that some pathologists have attempted to found certain subdivisions of the fatty tumor, which, while they are of doubtful histological propriety, are altogether destitute of practical value.

Fig. 27.



Minute structure of a fatty tumor.

Fatty growths are most common in the subcutaneous cellular tissue, but they are not confined to this substance; for in many cases they send prolongations around the muscles, tendons, fasciæ, vessels, and other structures. Thus a fatty tumor of the neck has been known to extend deeply between the trachea and œsophagus, or to dip in between the carotid artery and jugular vein, or to pass down behind the sternum and clavicle into the chest. A fatty growth of the wall of the abdomen sometimes extends into the cavity of that name; and, on the other hand, such a tumor occasionally begins in the subperitoneal cellular tissue, and ultimately descends through the inguinal canal, or some abnormal outlet, down into the scrotum, thus simulating hernia of the groin. It must be obvious that all such arrangements, which, however, are fortunately rare, must greatly embarrass both our diagnosis and our attempts to remove the morbid mass.

Fatty tumors are soft, doughy, and semi-elastic; properties which, in general, enable the surgeon readily to distinguish them from other morbid growths. Their boundaries are usually well defined, especially when they are superficial or pediculated. Sometimes, however, they are insensibly lost in the surrounding parts, being spread out beneath the skin, and sending processes among the muscles, or their fasciculi. In many cases they have an irregular, lobulated surface; while in other cases, and perhaps in the majority, they are perfectly smooth and uniform. There is no enlargement of the subcutaneous veins, no disease of the skin, no pain, and no tenderness on pressure. The progress of the tumor is, in fact, quite indolent; the only inconvenience which the patient experiences being caused by its weight and bulk. The general health is usually perfect. These circumstances, with a careful consideration of the history of each case, will commonly serve to distinguish fatty tumors from other morbid growths, whether benign or malignant in their character.

Fatty tumors are liable to inflammation, suppuration, ulceration, and gangrene. These events, however, are very infrequent, and are usually induced by mechanical pressure, by caustic applications, and by inefficient nourishment, in consequence of a loss of their vascular and nervous supply from the pendulous or overgrown character of the morbid mass. In a tumor of this kind, about the volume of an orange, which I removed many years ago from the top of the left shoulder of a girl of eighteen, the ulcer had a remarkably foul, unhealthy aspect, with thin, everted edges; the pain was at times quite severe, and the discharge was of a sanious nature, intermixed with globules of fat. Various attempts had been made, but without success, to heal it up, and no cause could be assigned for its formation. The general health had been a good deal impaired, and for some time past there had been irregularity of the menstrual function. The ulcer was included in the incisions, and a speedy recovery was the result.

When the fatty tumor becomes inflamed, it may suppurate, the pus occurring either as an infiltration or as a distinct abscess. Occasionally it serves as a nidus for the deposit of osseous matter, as in the case already referred to.

Again, such tumors now and then undergo a sort of fibrous or cartilaginous degeneration, not uniformly, but at certain points of their extent. Nodules, varying in size from a hazel-nut to a pullet's egg, may thus be formed, having a firm, characteristic consistence, more or less movable, and contrasting singularly with the other structures. Finally, they occasionally contain cysts filled with various kinds of substances, as oily, serous, or gelatinous. The walls of the cysts may be very thin and transparent, or thick, opaque, and perhaps even partially calcified.

It is not easy to determine how fatty tumors are developed. The difficulty which surrounds the subject is not cleared up by assuming that they are merely hypertrophies of the natural adipose tissue. This is doubtless the fact: but we cannot explain why such an occurrence should take place at one point rather than at another, or why, indeed, it should happen at all. The exciting cause of the morbid growth has sometimes been traced to external injury, as a blow, contusion, or steady mechanical compression; but in the generality of cases no reason whatever can be assigned for its production.

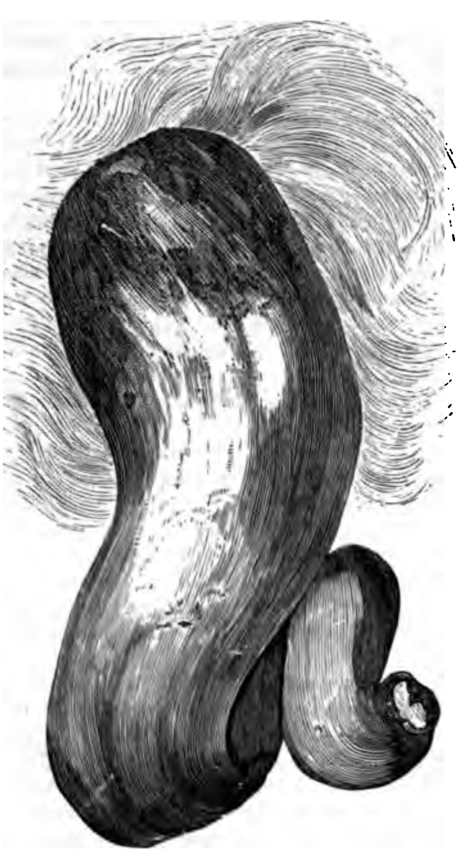
Both sexes are liable to this formation, but whether in an equal degree or not, is not ascertained. It is most common in young adults and middle-aged persons.

The medical treatment of this class of morbid growths is most unsatisfactory; for there is no remedy of which we have any knowledge that is capable of arresting its progress, or causing its removal. If the reverse is occasionally the case, it serves only as an exception to the rule, and nothing else. The instance of Mr. Brodie, in which he succeeded in removing a large mass of fat from a man's chin and neck, by the free and persistent use of the solution of potassa, may be regarded as a remarkable example of unexpected success. He commenced with half a drachm of the fluid three times a day, and gradually increased the dose to a drachm. At the end of a month there was a sensible diminution in the volume of the tumor, which steadily continued as long as the medicine was persevered in. Some time afterwards Mr. Brodie substituted the tincture of iodine, which had just then come into use, but the tumor again increased. Finding this to be the case, the alkali was resumed and continued, off and on, until the tumor was almost entirely dispersed. Altogether, the man took an enormous quantity of the medicine. I am not aware that the same happy effects have been realized from this remedy by other practitioners.

All local applications are equally unavailing. This is true alike of steady and systematic compression, of mercurial and other inunctions, and of frictions with stimulating liniments and embrocations. The absorbent vessels in these tumors are few and feeble, and this is probably the reason why all remedies of this description are so utterly valueless as curative agents.

The manner of excising such tumors is generally sufficiently simple. Any diseased skin that may exist should be removed along with the morbid mass, which should be enucleated by a rapid dissection, care being taken that not a particle of the deposit is left behind; otherwise reproduction may take place. When the tumor is superficial the operation is easily performed and soon over; but when it is deep-seated, or when it sends processes among the surrounding structures, it may be one of great difficulty and perplexity, requiring the most consummate skill for its successful execution, and the most thorough knowledge of the anatomy of the parts. For the reasons already mentioned, the operation is sometimes nearly bloodless. I have, indeed, seldom found it necessary to apply more than two or three ligatures, whatever may have been the volume of the tumor.

Fig. 28.



Horny excrescence growing from the scalp.

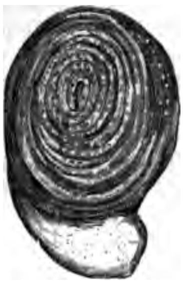
4. HORNY TUMORS.

The skin is occasionally the seat of a very curious growth, known as the horn-like excrescence, from its resemblance to the horn of the sheep and goat. A more appropriate name would be the horny tumor. It is met with principally in those parts of the body which abound in sebaceous follicles, as the face and forehead. In seventy-one cases collected by Villeneuve, the tumor in twenty-six was seated on the scalp, in five on the nose, in two on the cheek, in one on the lower jaw, in four on the chest, in four on the back, in three on the anus and penis, in four on the buttocks, in twelve on the thigh, in two on the knee, in two on the ham, in one on the leg, and in three on the foot. In the cases that have come under my own observation, it was seated on the lower lip, the ear, and the chin; others have met with it on the scrotum and hand. It appears to occur with nearly equal frequency in both sexes, and it occasionally begins at a very early period of life, although in the great majority of instances it does not come on until after the age of forty. In two cases I have seen small but well-marked growths of this kind in children under ten years of age. Several such excrescences are sometimes observed in the same person.

The size, shape, color, and consistence of the horny tumor are subject to much diversity, depending upon its age, and other circumstances. A length of from three to six inches by half an inch to an inch in diameter, as in fig. 28, is by no means uncommon. In the British Museum there is said to be a growth of this description, eleven inches in length by two and a half in circumference; and examples of a still more remarkable nature have been reported by authors. In that curious book, An Essay for the Recording of Illustrious Providences, by Increase Mather, are briefly mentioned the particulars of the case of a "man that has an horn growing out of one corner of his mouth, just like that of a sheep; from which he has cut seventeen inches, and is forced to keep it tyed by a string to his ear, to prevent its growing up to his eye."

The shape of these excrescences is usually conical, being larger at their adherent than at their free extremity, which is always somewhat tapering, and their direction is either spiral, twisted, or bent, so as, in the main, to bear a striking resemblance to that of the horn of a sheep. In a case recorded in the New York Medical Repository for 1820, an enormous growth of this kind, measuring fourteen inches in circumference at its shaft, is stated to have consisted of three branches. The surface is generally marked by rough circular rings, indicative of the successive steps of their development. Now and then it is imbricated, knobbed, or covered with small pearl-colored scales. In color they vary from a dingy yellow to a dark grayish, brown, or black, according to their age, and the amount of their exposure. They are more or less flexible, and of a firm, fibro-cartilaginous consistence. Their internal arrangement, as seen on a section, is longitudinally lamellated, as in fig. 29.

Fig. 29.



A section of a horn showing its lamellated structure.

When burned, these excrescences exhale a characteristic animal odor. They are chiefly composed of albumen, in union with a small quantity of mucus, phosphate of lime, and choride of sodium, with a trace of lactate of soda. On the addition of acetic acid, numerous epidermic scales become apparent, possessing all the characteristic properties of such structures. Under the microscope, the minute texture of these growths exhibits epithelial cells, which, according to Erasmus Wilson, are of a flattened shape, closely condensed, and, here and there, fibrous in their arrangement. They are somewhat larger than those of the epidermis, and possess nuclei, for the most part of an oval shape, their long diameter measuring $\frac{1}{2600}$, the short $\frac{1}{3300}$ of an inch. The average size of the flattened cells is about five times greater than that of the nuclei.

Human horns are generally, if not invariably, connected with the sebaceous follicles, in which they probably take their rise. Their development is frequently directly traceable to the effects of chronic inflammation, or external injury, as a burn, wound, or contusion. When first observed, they are quite soft, semi-transparent, and invested by a distinct cyst, which, extending over their base, is gradually and insensibly lost upon their trunk. Very soon, however, they become hard, and, assuming a darker hue, thus acquire the real properties of the horny tissue as it exists in the inferior animals. Their growth is always very slow, from three to five years elapsing before they attain any considerable bulk.

Although these excrescences sometimes drop off spontaneously, a cure rarely, if ever, follows such an event; for, as the matrix remains, it soon becomes the starting-point of a new growth, which, pursuing the same course as its predecessor, may, in time, acquire a similar, or even a greater, bulk. The proper remedy is extirpation, performed in such a manner as to include the whole of the epigenic cyst in two elliptical incisions, the edges of which are afterwards carefully approximated by suture and adhesive strips. It has been suggested that we might get rid of these bodies by softening and dissolving them with alkalies and water-dressings; and then, after they have dropped off, to prevent their reproduction by touching the matral cyst freely and repeatedly with nitrate of silver, with a view of preventing the tendency to abnormal cell-formation. Such a procedure, however, besides being tedious, must be very uncertain, and is, I imagine, altogether more disfiguring in the end than excision.

5. FIBROUS TUMORS.

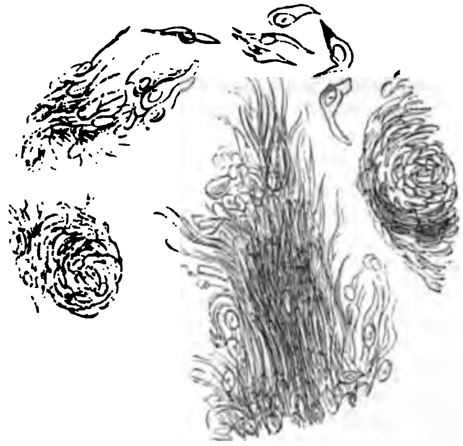
The fibrous tumor owes its name to the peculiarity of its structure, which strongly resembles the fibrous tissue in the normal state. One of the best specimens of this variety of morbid growth is to be found in the uterus of elderly females, where it sometimes attains a weight and magnitude equal to those of the body of the patient. It also occurs in the cellular tissue, both subcutaneous and intermuscular, in the testicle, the ovary, and other parts of the body. My cabinet contains a large fibrous tumor, weighing nearly five pounds, which I removed from the interior of the scrotum of a young man of twenty-five, but which had no connection whatever with the testicle. A remarkable fibrous tumor is sometimes seen growing pendulously from the lobe of the ear. Keloid formations of the skin obviously belong to the present class of morbid products, although they usually contain an inordinate quantity of plastic material. Fibrous growths occasionally occur in the interior of the joints, especially the elbow and knee, in the latter of which they sometimes attain the volume of a pullet's egg. The dura mater, periosteum, and fibrous envelopes of the muscles are all liable to their formation, although the occurrence is unusual. Finally, fibrous tumors are often met with in the neck, either just beneath the skin or deep among the muscles and lymphatic ganglions.

The fibrous tumor, although of slow growth, may, in time, acquire an enormous bulk, as is exemplified in the immense masses which we occasionally find in the neck, the uterus, and some other parts of the body. It feels heavy and incompressible, is globular, ovoidal, or pyriform in shape, and has generally a smooth, even surface, although cases not unfrequently occur where it is remarkably lobulated, or marked by numerous elevations and depressions. In the uterus and the joints it is often attached by a narrow neck, but almost everywhere else it is in immediate contact, on all sides, with the structures in which it is developed, its adhesions being effected solely by cellular tissue. Generally solitary, it occasionally occurs in considerable numbers, more particularly in the uterus, where there are sometimes from six to a dozen in the same specimen.

The structure of the fibrous tumor is characteristic. As its name indicates, it is composed of fibrous matter, the filaments of which cross each other in every conceivable manner, forming thus an intricate network, which the most careful dissection fails to unravel. These filaments are of variable size and shape, and are so intimately compacted together as to constitute a dense, firm, inelastic substance, so characteristic of this kind of product. It is only in rare cases that their passage across each other leaves any interspaces for the lodgment of fluid or solid matter. They are of a grayish or pale drab color after maceration, but in their natural state they are rosaceous, reddish, or even purple, their complexion depending upon the amount of blood they contain. Occasionally they have a silvery, glistening appearance.

The fibrous tumor has seldom any distinct capsule; the tissues around it are, it is true, usually a good deal condensed and thickened, but the covering thus derived is altogether adventitious and secondary, forming none of the essential elements of its growth. Few vessels can be traced into its substance, and these are rarely of any considerable size; a circumstance the more surprising when it is recollected what immense bulk it sometimes acquires. No reliable chemical examination has yet been made of this variety of tumor, but it is probable that it consists essentially of gelatine, as this substance is largely furnished by protracted boiling. Under the microscope it exhibits nucleated cells, sometimes in great numbers, of an oval, rounded, or elongated form, which are always rendered very conspicuous if the part be previously treated with acetic acid, as in fig. 30.

Fig. 30.



Microscopical characters of a fibrous tumor from the submaxillary region, from a drawing by Dr. Packard.—472 diameters.

Growths of this kind sometimes contain colloid matter, lodged in distinct cells in their interior; it possesses the ordinary physical and microscopical characters, and probably serves to give additional impulse to the development of the tumor, which often increases with great rapidity, and thus soon acquires a large bulk.

The fibrous tumor seldom takes on malignant action, although it is not incapable of it. Its general tendency is gradually to increase, to impair function, and ultimately to wear out life by its secondary effects. The older formations of this kind nearly always contain adventitious deposits, especially the calcareous, which often exists in considerable quantity. The cartilaginous is also not uncommon. Sometimes large cavities, containing serosity, pus, and other substances, are found in them. Their progress is usually painless, except when they compress important parts, the inconvenience which they occasion being dependent mainly upon their weight and bulk.

There is a form of fibrous tumor to which the term *fibro-plastic* has recently been applied, as denotive of its peculiar composition. It is, in fact, merely a modification of the one just described, with a predominance of the plastic element, or, at all events, a very conspicuous exhibition of it. It is met with chiefly in certain pendulous growths of the ear, in elephantiasis, and in certain formations of the skin, especially in keloid. It is also found in the subcutaneous and intermuscular cellular tissue of the neck, trunk, and extremities. When cut, it grates under the knife, the surface exhibiting a pale yellowish, greenish, or bluish glistening basis-substance, intersected by whitish, opaque filaments. These filaments, which, by their interlacements, form the stroma of this variety of tumor, are generally disposed in wave-like lines, but in many specimens they are very irregular, and seem to observe no definite arrangement. The matter which occupies the cells of the stroma is very succulent, being pervaded by a peculiar fluid, of a yellowish, oily appearance, which gives the mass an infiltrated, anasarcous condition.

The fibro-plastic tumor essentially consists of plastic matter, its development being effected from nucleated blastema, in the same manner as in ordinary lymph-growth. It occurs principally in young and middle aged subjects, and is usually more rapid in its march than the purely fibrous formation, into which it sometimes partially degenerates, its plastic material being supplanted by the fibrous.

The fibrous tumor, as already stated, sometimes takes on malignant action, its tissues serving as a nidus for the deposition of carcinomatous matter. It is impossible to determine what are the circumstances which predispose to, or influence, such an occurrence; but there can be no doubt that it is governed by the same laws as those which preside over the development of cancer in the primitive structures generally, and that the change does not consist merely in a degeneration, properly so termed, of the fibrous substance, but of an entirely new formation. What has recently been described as the *recurring fibroid tumor* is probably originally of a malignant nature, but does not show its real character until it is called into play by some disturbing agency, either local or constitutional, or, perhaps, both. At all events, this morbid growth often remains for a long time in a state of latency, when, it may be all of a sudden, it assumes an extraordinary degree of activity, and soon exhibits the worst malignant tendencies. Casual inspection of the fibroid tumor might lead to the supposition that it was of a fatty substance, so closely do its external properties resemble those of the adipose tissue; but a careful examination with the microscope soon dispels this illusion, and clearly proves that it is essentially composed of the fibrous element, with, now and then, a small quantity of oily or fatty ingredients. Its texture is sometimes remarkably lobulated, soft, and even brittle, the slightest traction separating it into numerous fragments; it often sends out small processes, which, extending far among the surrounding structures, are apt to be left behind during extirpation, unless great care is used in tracing them out. In its color it varies from drab or grayish to white or pale yellowish. A very common site of this tumor is the superior maxillary sinus; it is also not unfrequently seen upon the face, especially at the side of the nose, taking its rise, apparently, in the periosteum of the upper jaw.

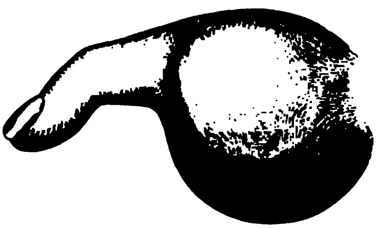
The diagnosis of the fibrous tumor must mainly be deduced from its history, and its consistence. Its development, as a general rule, is tardy, there being a marked difference, in this respect, between it and the carcinomatous formations, even between it and scirrhus. Usually beginning in a little hard nodule, or lump, several years commonly elapse before it attains any considerable bulk, especially when it is developed among the external tissues; its progress is comparatively painless, the chief inconvenience occasioned by it being of a mechanical nature. The tumor feels hard, firm, and inelastic; it is more dense than encephaloid, but not as solid and dense as scirrhus. Its consistence is usually uniform; not hard at one point, and soft at another, but of the same character throughout. Its surface, too, is commonly smooth; and there is nearly always, unless the growth is very large, an absence of enlargement of the subcutaneous veins. In its earlier stages it is somewhat movable, except when it springs from the periosteum; but by degrees it contracts adhesions, and becomes firmly fixed in its position.

The fibrous tumor is rarely, in any of its forms, amenable to local or constitutional means. When it is favorably situated, pressure, steadily and systematically pursued, may sometimes be serviceable; but it is so seldom that this is the case that hardly any calculations of a curative character are to be based upon it. In the early stage of the development, before any great firmness and density of structure have been attained, a mild course of mercury may be tried, its constitutional impression being persistently yet most gently maintained for several successive months, or alternated with that of iodide of potassium, also an agent of some consequence in the softer forms of fibrous growths, although rarely of any benefit in those of maturer development. But the surest remedy, when the tumor is accessible, is excision, performed early and efficiently, by dissection and enucleation. Hemorrhage is usually slight, and recurrence impossible, unless, as sometimes happens, the morbid mass has become the nidus of carcinomatous deposit. As this cannot always be certainly predicted beforehand, the prognosis should not be too sanguine.

6. CARTILAGINOUS TUMORS.

The cartilaginous tumor, to which Müller has applied the term enchondroma, holds, histologically speaking, a position intermediate between the fibrous and osseous, being harder than the former and softer than the latter. Occurring in various parts of the body, as the ovary, testicle, mamma, and parotid gland, as well as in the intermuscular cellular substance, it is most frequently found in connection with the skeleton, its most common sites being the metacarpal bones and the phalanges of the fingers. I have seen large and numerous growths of this kind form simultaneously upon both hands and both feet, causing hideous deformity and almost complete loss of function of the affected parts. Although it occasionally takes place in elderly subjects, yet it is by far most frequent in young persons, especially such as are of a weak, rickety constitution; and is often associated with a remarkably stunted state of the body. The annexed sketch, fig. 31, from a specimen in my possession, conveys a good idea of the external characters of a cartilaginous tumor as it occurred upon one of the fingers.

Fig. 31.

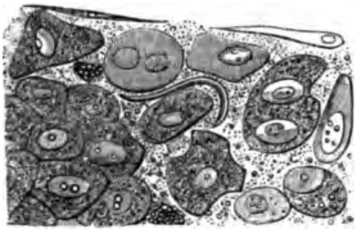


Enchondromatous tumor: external view.

The structure of this variety of tumor is subject to great diversity; hence it is rarely found to be of a uniformly cartilaginous character, but, in most cases, its substance is intermixed with fibrous and fibro-plastic matter, if not also with more or less of osseous, or calcareous, especially when the growth is of long standing; not unfrequently it contains large cysts filled with various kinds of substances, either solid or fluid. To the hand it generally imparts the sensation of unusual firmness and solidity; it is destitute of elasticity, is generally distinctly circumscribed, and is nearly always strongly adherent to the structures from which it springs. Its surface is sometimes smooth, but more commonly it is lobulated, or marked by irregular prominences and depressions. No pain usually exists, or, if suffering is present, it is owing rather to the pressure which the tumor exerts upon the neighboring parts than to any disorder of its own sensibility.

Ordinarily the consistence of this tumor ranges from that of the vitreous humor, or solid albumen, to that of cartilage, different sections of it often exhibiting, as just stated, different degrees of firmness. In general, the mass is easily cut with the knife, the instrument

Fig. 32.



Minute structure of enchondroma.

sometimes causing a creaking noise. It is of a whitish, grayish, or bluish aspect, and is characterized by a peculiar linear arrangement. Under the microscope it presents numerous cells, as in fig. 32, of an oval or rounded shape, from the $\frac{1}{700}$ to $\frac{1}{1600}$ of an inch in diameter, loosely imbedded in an intercellular hyaline substance, and containing each one or more nuclei and nucleoli. In the older growths, some of the nuclei and nucleoli are shrivelled, others are filled with oil granules, while others, again, are marked by projections similar to those of cartilage in process of ossification.

Chemistry has shown that this tumor is mainly composed of chondrine, a peculiar form of gelatine, in union with phosphate of lime. The animal matter is readily extracted by boiling, and differs from ordinary gelatine chiefly in being precipitated by some of the salts of lead, alum, and iron.

The cartilaginous tumor is sometimes enveloped by a distinct cyst, composed of condensed cellular substance; at other times, it is entirely destitute of such a covering, especially when it originates in the interior of the organs. Its vascularity is often very great, a circumstance which readily explains the astonishing rapidity which occasionally marks its growth, cases having been observed in which, in the course of a few months, it attained the bulk of an adult's head, or even of the chest of the patient. Such an occurrence, however, is extremely uncommon; for, in general, the progress of the cartilaginous tumor is singularly tardy, although it may, in time, acquire an extraordinary volume.

The progress of the cartilaginous growth is variable; in general, it is painless and indolent, causing little or no inconvenience, save what results from its weight and pressure; sometimes, however, it inflames and ulcerates, and in this way a large cavity is occasionally formed, attended with copious discharge and excessive constitutional disturbance, rapidly followed by hectic fever. Portions of such tumors sometimes, as already stated, undergo various transformations, as the cystic, fatty, and calcareous. It is also probable that it may occasionally become the seat of carcinoma, resembling, in this respect, some of the other benign formations. The only remedy for this tumor is early and efficient extirpation. When it is closely connected with bone, amputation will generally be required.

7. OSSEOUS TUMORS.

Osseous tumors, usually known by the name of exostoses, are mostly found in connection with the skeleton, especially the skull and thigh-bone, presenting themselves in various forms and sizes, from that of a pea up to that of a fœtal head; hard and compact, like the normal bone, which they closely resemble in structure and composition; slow and painless in their progress; never degenerating into malignant disease; unamenable to ordinary medication; and requiring removal only when they seriously interfere with the exercise of important functions. The exciting cause of this class of tumors is not well understood; occasionally their development may be traced directly to external injury, but in general no reason whatever can be assigned for it. Commencing usually upon the outer surface of the bone, beneath the periosteum, their foundation is sometimes laid in the periosteum itself, the connection with the primitive bone being, perhaps, originally of a cartilaginous character. The osseous tumor is most common in persons after the meridian of life, and occasionally occurs in large numbers, depending apparently upon the existence of a real exostotic diathesis.

8. CALCAREOUS TUMORS.

The calcareous tumor is very uncommon, and is generally the result of a degeneration of a lymphatic ganglion, nearly always one of the neck, in the vicinity of the lower jaw. The gland having perhaps been for a long time enlarged and indurated, usually from a deposit of tubercular matter, gradually diminishes in size, and is finally transformed into a hard, firm substance, resembling baked earth. It has none of the properties of genuine bone, and consists almost entirely of carbonate and phosphate of lime, cemented together by a minute quantity of animal matter. It is usually of small size, of a spherical form, and surrounded by an imperfectly constructed capsule. As it is not amenable to absorption, the proper remedy is excision, performed whenever it is found that the little tumor is in the way of comfort, or good looks.

Calcareous deposits are sometimes found in other structures, as fibrous tumors of the uterus, the vaginal tunic of the testicle, the bronchial lymphatic glands, and the pulmonary tissues; but as they do not interest the surgeon they may well be passed over here.

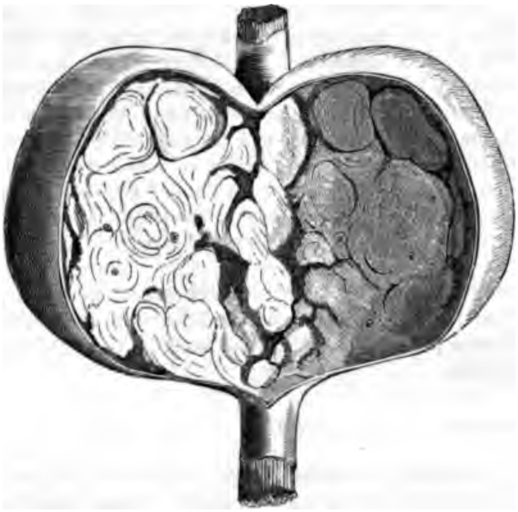
9. NEUROMATOUS TUMORS.

The nerves of animal life, especially the radial, ulnar, median, tibial, and peroneal, are subject to two forms of tumors, or morbid developments, known, respectively, as the neuromatous growth and the painful tubercle, although their structural differences are not always very well defined. The latter of these affections, incidentally noticed by Petit, Cheselden, and other observers, was first accurately described by Mr. William Wood, of England, in 1812. The neuromatous tumor, properly so denominated, has been particularly studied and delineated by Mr. Robert W. Smith, of Dublin, who published a splended monograph on the subject in 1849.

The neuromatous tumor may be solitary, or there may be a considerable number, varying in size from that of a pea to that of an almond, an egg, or even an adult head. It is solid to the touch, firm, inelastic, and of an oblong, ovoidal, or irregularly compressed form. When small, it has generally a distinct cyst, of a cellulo-fibrous structure, filled with a transparent jelly-like substance, and developed within the neurilemma of the affected nerve, the filaments of which are separated from each other, and spread out over the surface of the tumor. In cases of long standing, or when the tumor has acquired an unusual bulk, the morbid mass is remarkably dense, white, or nearly so, homogeneous, and destitute of a cyst, properly so called.

The neuromatous tumor occurs in both sexes, and at various periods of life, though it is most common in males and in middle age. Its progress is usually slow, and it seldom attains any great volume. The exciting causes are generally very obscure, but in some cases it is plainly traceable to the effects of external injury, as a wound, blow, or bruise. Occasionally it follows upon amputation, the nerves of the stump becoming enlarged and bulbous. The pain which attends this disease is very variable, both in degree and character. In most cases it is of a neuralgic nature, exceedingly severe, sharp, darting, pungent, or stinging, and liable to periodical exacerbations, dependent apparently upon atmospheric vicissitudes, and disorder of the digestive functions. The slightest pressure, friction, or manipulation causes an increase of suffering, which, under such circumstances, not unfrequently amounts to great agony. The parts beyond the tumor, especially those supplied by the affected nerve, are cold, numb, and almost powerless. The pain is sometimes seated in the neighborhood of the tumor rather than in the tumor itself; and occasionally, again, though this is rare, there is an entire absence of local distress. The general health may remain good, but in the great majority of instances it is more or less impaired; and the system, constantly tortured by the excessive suffering, is gradually reduced to the utmost prostration.

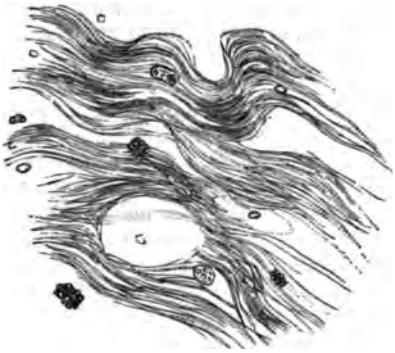
Fig. 33.



Section of a neuromatous tumor, with the nerve passing to and from it.

The accompanying sketch, fig. 33, affords an excellent illustration of the anatomical characters of a neuromatous tumor of the leg, situated along the course of the peroneal nerve. It had existed for nearly twenty years, during the last three of which it had been exquisitely tender and painful. The extirpation was effected by Dr. Dalton and Dr. Hoffman, of Ohio, who were kind enough to send me the specimen. The operation was followed by sloughing of the fourth and fifth toes.

Fig. 34.



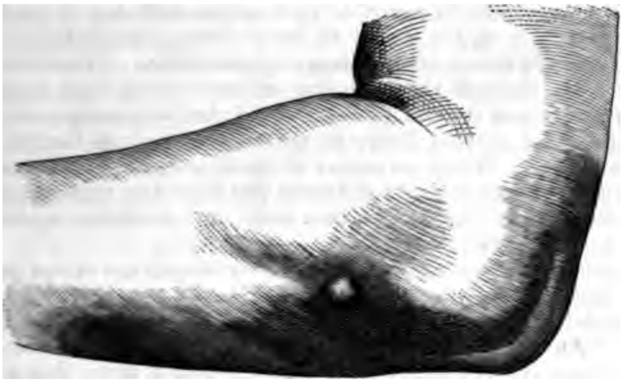
Microscopic structure of a neuromatous tumor.

A large quantity of fibrous matter enters into the composition of the neuromatous tumor, forming a stroma interspersed with granules and corpuscles, as seen in fig. 34.

The only effectual *treatment* is excision. As long, however, as the tumor is painless, or causes no inconvenience by its size or situation, the best plan is to let it alone. When the reverse is the case it is our duty to extirpate it. The operation is usually quite simple, and devoid of danger. In general, an attempt should be made to enucleate the tumor, by pushing aside the nervous filaments which are spread out over its surface, and which may thus occasionally be preserved from harm. When this is impracticable, from the manner in which the parts are fused together, the morbid mass should be exposed by a free incision, and lifted out of its bed by dividing the affected nerve immediately above and below, over a grooved director. The loss of motion, occasioned by this proceeding, even when it involves a comparatively large nerve, is usually restored in a very short time. Indeed, the chief inconvenience to which it gives rise is a sensation of coldness in the distal part of the limb, which may, however, remain for years. Amputation has been resorted to for the cure of this complaint; but it is difficult to conceive of a case where it would really be necessary.

The painful subcutaneous *tubercle*, seen in fig. 35, is generally situated, as the name implies, just beneath the skin, in the areolar tissue, where it is usually connected with one or more very delicate nervous filaments, slightly enlarged, and surrounded by cellulo-fibrous, fibrous, or fibro-cartilaginous matter, freely interspersed with corpuscles, as seen in fig. 36. On being cut out, it looks very much like a small mass of adipose substance. Few vessels can be discerned in it. It is always remarkably small, seldom exceeding the volume of a pea; very movable; exquisitely tender to the touch; and the seat of frequent pain, often of a neuralgic character, and subject to constant exacerbations from the most trifling causes. It is said to be most common in the lower extremities, but this does not accord with my experience, most of the cases that have come under my observation having occurred in the arm, forearm, and shoulder.

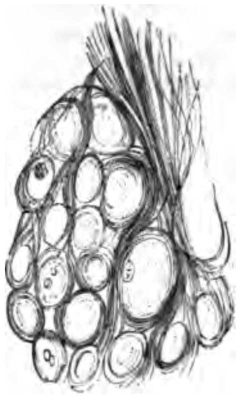
Fig. 35.



Painful subcutaneous tubercle.

The painful tubercle is generally single, or, if multiple, it is seldom that we see more than two or three in the same person. It occurs in both sexes, but much more frequently in women than in men, the reverse being the case in regard to the neuromatous tumor. Its development is usually tardy, and several years often elapse before it becomes very tender and painful. Women of a nervous, hysterical temperament appear to be most prone to its occurrence. During its development it always involves the skin.

Fig. 36.



Microscopic structure of the subcutaneous tubercle.

The situation of this tumor just beneath the skin, or in the skin and areolar tissue, the absence of discoloration of the surface, the peculiar character of the pain, the intolerance of manipulation, and the history of the case, will generally suffice to determine the diagnosis.

The only remedy for this affection is free excision, including a small portion of the surrounding healthy integument. The disease never returns at the cicatrice, although it may occur afterwards in other parts of the body.

10. ENCYSTED TUMORS.

The class of encysted tumors is a large and important one; for it comprises quite a number of morbid products, which, whether they be viewed with reference to the frequency of their occurrence, or the extraordinary bull are capable of attaining, deserve more than ordinary attention. Thei tents, which are of a singularly diversified character, may be either semi-solid, or liquid. Their structure is sometimes very simple; at times extremely complex. Hence the division of encysted tumors simple and compound. In regard to their origin, some are of new form but many, if not most, are merely so many alterations effected in the tive structures; in fact, merely so many hypertrophies. Occurring in every organ and tissue of the body, they are particularly liable to show selves in the skin and mucous membranes, the glandular organs, as the t testicle, liver, and thyroid body, in the ovaries, and in the subcuta cellular substance. While no period of life is exempt from them, th most common between the ages of twenty and forty-five, especially in fe who are also more subject to them than males, and in whom they occasi attain an enormous volume.

In respect to their structure, some of these tumors are of the most s character possible, consisting merely of a thin cyst, sac, or capsule, occ by the natural secretion of the part, more or less altered by its prot retention. An excellent type of this variety of morbid product is afl by the sebaceous tumor, which is, in reality, nothing more than a seb follicle of the skin, in a state of hypertrophy from the occlusion of its c and the consequent retention of the sebaceous matter. The immediate of the obstruction is inflammation, producing adhesion of the opposite of the outlet of the follicle, and thus constituting the first link in the of morbid action. The second is the retention of the normal secret the follicle, which, being tightly pent up, undergoes important changes in its physical and chemical properties, leading to irritation, and som even to inflammation of the sac, which, gradually enlarging before the mulating and burdensome mass, at length forms a tumor perhaps as la a medium-sized orange. The little encysted tumor which we sometim upon the lower lip and upon the vulva arises in a similar manner. Th bability is that ranula owes its origin to a similar circumstance. C encysted tumors beneath the skin, containing serum, blood, or solid m are produced by the occlusion of one of the cells of the cellular tissu walls of the affected cavity forming a characteristic cyst. Obstructio lactiferous duct has been known to produce the encysted milk tumor breast. In all these instances, as well as in many others that might duced, we perceive that the mode of formation is extremely simple, ob tion of the natural outlet of the part, and the retention of its proper sec being the exciting cause of the disease.

Sometimes the cysts which form the distinguishing feature of this v of morbid product are an entirely new growth, and then it is not alway to explain their origin. The cysts which are found in cystic sarcoma testicle have been supposed to owe their development to obstruction seminiferous tubes, but I question whether such a mode of explanatio all tenable. In the few cases in which I have had an opportunity of ex ing these tumors, I have been led to conclude that their origin was gether foreign to the canalicular structure of the organ. It is certai hundreds, and sometimes thousands, of cysts are formed in the testicl after its seminal tubes are apparently completely annihilated, as is pro the large size which such tumors often attain, and by the total absence primitive structures. The more plausible conjecture is that the develo is effected in the plastic matter which accompanies the morbid action, same manner that cells are formed in the original tissues. The cysts in osteo-sarcomatous formations of the lower jaw have probably a s origin.

The contents of this form of encysted tumor must necessarily vary, as may be gathered from what precedes, according to the structure and functions of the affected part. Thus, in the mamma the tumor contains milk, in ranula saliva, and in a sebaceous formation sebaceous matter; altered, in every instance, in its physical and chemical properties, by the action of the inclosing cyst. The cyst itself is always solitary, and generally composed of a single layer, its external surface, which is rough and flocculent, being adherent more or less firmly to the surrounding tissues, while the internal one is usually smooth, shining, or glossy, without septa, and in immediate but loose contact with the proper contents of the tumor. It is usually of a cellulo-fibrous structure, and varies in thickness from the merest film up to that of a stratum several lines in depth. In cases of long standing we find it occasionally partially converted into a substance resembling fibro-cartilage, cartilage, bone, or earthy matter.

A cyst is said to be *multilocular*, or compound, when it consists of a number of compartments, cells, or cavities, or, to use a familiar expression, rooms, or chambers. This arrangement is brought about by the existence of membranous processes, which are attached to the inner surface of the parent cyst, from which they branch out so as to intersect each other in different directions. It might be very easily imitated by sewing pieces of linen across a common bag, separating the main cavity into a number of small ones. The chambers sometimes communicate with each other; at other times they are perfectly closed at every point. What is very remarkable, is that they frequently contain different kinds of products; one, perhaps, a serous fluid, another a jelly-like substance, another blood, and, finally, a fourth, perhaps, a solid material. In general, the older the cyst is the more likely will it be to contain some outré substance. The walls of these sacs are generally very thick, and of a dense fibrous structure, with a tendency to the fibro-cartilaginous degeneration. The septa, or internal partitions, are of a similar character. Numerous vessels occur in them, thus enabling us to explain the rapid growth and large bulk which these tumors occasionally attain.

The most common situation of this tumor is the ovary; it is also found in the mammary gland, the thyroid body, the testicle, and the cellular tissue. It is of irregular shape, and often grows with great rapidity.

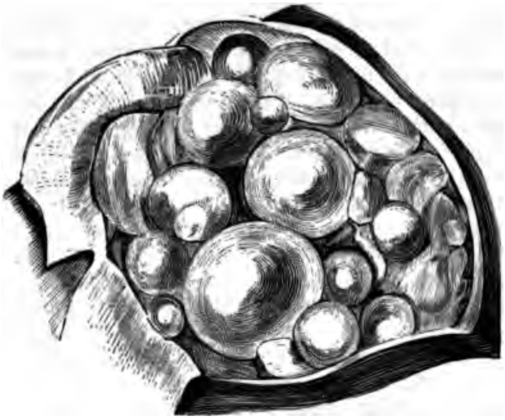
Encysted tumors are seldom benefited by constitutional medication; indeed, apparently never, except in so far as it may have a tendency to improve the general health, and thus retard their development. Their contents do not seem to be amenable to the action of the absorbents. When situated superficially and of small size, they are sometimes benefited, though seldom cured, by compression, aided by sorbefacient applications, particularly the dilute tincture of iodine. A more certain plan is to break the cysts or incise them subcutaneously, so that, their contents having escaped into the surrounding cellular substance, their walls may collapse, and ultimately unite by adhesive inflammation. When the tumor, however, is deep-seated, sometimes iodine injections may be advantageously employed, the operation being performed in the same manner as in hydrocele of the vaginal tunic of the testicle. A seton, too, is an eligible procedure. When the cysts are large or numerous, and, above all, when the primitive textures are, in great measure, if not entirely, annihilated, the only course likely to succeed is excision of the entire mass, care being taken not to leave the slightest remnant, otherwise reproduction will be certain to occur. Too much stress cannot be laid upon this injunction. For want of this precaution, I have known a patient obliged to submit to not less than three distinct operations for the cure of a tumor originally not larger than a pigeon's egg, and which ought to have been effectually removed at one sitting. A secreting surface, hardly the size of a pin's head, is large enough to reawaken disease. The removal may sometimes be effected by enucleation; at other times, and more generally, a minute dissection is necessary. The proceeding need not be at all bloody, unless the tumor is seated among very vascular parts, or the knife is carried too far away from the encysted mass.

11. HYDATIC TUMORS.

Under this head I propose to describe a form of morbid growth, essentially dependent upon the development of a cyst, inclosing an entozoon, vesicular worm, or parasite, denominated a hydatid. It is, as will be perceived, altogether different from the other varieties of cystic tumors, and therefore requires separate consideration. The term hydatid is a generic one, including several species of vesicular worms, of which the most important, surgically considered, is the acephalocyst.

This hydatid most commonly infests the liver, ovary, and uterus, but is also met with, although very rarely, in the mamma, testicle, bones, and serous cavities. I have a beautiful specimen which I removed from the deltoid muscle. Varying in volume between a mustard seed and a small orange, it is of a globular figure, of a whitish, semi-opaque appearance, and composed of a vesicle, or bladder, filled with serous fluid, and surrounded by a cellulo-fibrous capsule, which thus isolates, and protects it from the circumjacent structures. It is usually gregarious, numbers of them inhabiting a common cyst, as seen in fig. 37; sometimes, however, there is only a solitary one, which is then commonly proportionably large. The contents of the animal are of a clear liquid character, remarkably saline to the taste, but destitute of odor and coagulability. The inclosing cyst is of a fibrous, or cellulo-fibrous structure, more or less vascular, and possessed of considerable strength. It is evidently a kind of adventitious membrane formed from plastic matter. Between this cyst and the parasite is commonly interposed a soft, pulpy, dirty-looking substance, the precise nature and object of which are not known. In consequence of their peculiar mode of generation, a large hydatid is sometimes found to contain several smaller, one within the other, like so many pill-boxes.

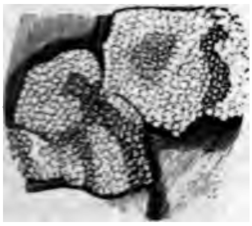
Fig. 37.



Hydatids inclosed in a common cyst.

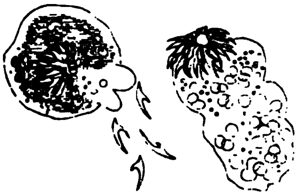
Although the hydatid itself consists of two distinct layers, it is generally so weak and delicate as to break under its own weight when removed from its inclosing cyst, shrinking into a soft, pulpy mass, not unlike the white of a hard-boiled egg, both in appearance and chemical composition. To the inner surface of the parasite are attached numerous little bodies, as in fig. 38, hardly as large as a grain of sand, of a spherical shape, and of a grayish color, each consisting of a delicate cyst, filled with echinococci. These animals, which derive their origin and support from the hydatid, soon separate themselves, acquiring thus a sort of independent existence, great numbers being often seen floating about in the parent liquor when they are yet hardly the two-hundredth part of an inch in diameter.

Fig. 38.



Cysts of echinococci.

Fig. 39.



Echinococci.

Each echinococcus consists of a body and a head, the latter being encircled by a row of teeth. The body, which is composed of solid, granular matter, has a curiously speckled appearance, owing to the presence of numerous ovoid bodies immediately beneath its outer coat. The teeth are spinous, sharp, hook-like, and perfectly characteristic. They are not easily decomposed, and are therefore capable of affording important diagnostic information. The various appearances here described are well illustrated in fig. 39.

Hydatids are usually short-lived, rarely lasting beyond a few years. Various causes may destroy them. Thus, some perish from suppuration, some from gangrene, some from the gradual drying up of their contents, and not a few from the pressure of their young. Under such circumstances, the inclosing cyst is often remarkably thickened, and even partially transformed into fibrous matter. I have seen cases where it had put on the appearance of the interior of an aneurismal sac. Great mischief, sooner or later, results from their presence, especially during the progress of their decay, nature often failing to eliminate them, and thus permitting them to excite violent irritation. A hydatid of the liver will occasionally induce fatal peritonitis, and the hardest structures, the osseous not excepted, are not always capable of withstanding its progress. A case has been reported of a parasite of this kind having perforated the scapula. In the lungs acephalocysts sometimes find their way into the bronchial tubes, from which they are afterwards ejected by expectoration.

There are no signs by which the existence of this parasite can be diagnosticated. Its presence in the discharges is the only reliable evidence of the kind. Some years ago I removed a small tumor from the arm, which had the character of an ordinary encysted formation, but which was unexpectedly found to contain an acephalocyst, the animal rolling out upon the floor before I had extirpated the inclosing capsule. No treatment, except excision, is of any avail in this affection, and that, of course, is only admissible when the tumor is situated in an external and accessible part of the body.

12. POLYPOID TUMORS.

These are certain growths, long known to pathologists and practitioners, to which the term polyp, polypus, or polypoid has been applied, apparently from some fancied resemblance they bear to the form of the animal described under that name by naturalists. They are found exclusively in the mucous cavities of the body, where they often attain a large bulk, and become a source of serious mischief. Occurring at all periods of life, they are particularly common in middle-aged and elderly subjects, and present themselves in several varieties of form, differing essentially from each other in their structure and habits, if not also in their mode of origin.

The situations in which these growths are most commonly met with are the nose and uterus; they are also sufficiently frequent in the ear, the maxillary sinus, the vagina, and the rectum. In the larynx and throat they are rare, but not, perhaps, as much so as is commonly supposed. They are generally solitary, but occasionally considerable numbers occur in the same subject and even in the same cavity. Their volume varies from that of a small pea up to that of an adult's head, depending upon the nature of the tumor, the locality which it occupies, and the amount of resistance offered to its extension. Their shape, which is usually materially influenced by that of the cavity in which they are developed, is conical, pyriform, or globular their attachment being generally effected by a narrow footstalk, root, or pedicle. Most of these growths belong to the class of benign structures, and hence the inconvenience which they occasion is chiefly of a functional character.

Polypoid tumors may conveniently be arranged under four heads, which judging from personal observation, comprise all the known and generally recognized varieties, without including any of the subordinate divisions made by certain authors, and which are altogether dependent upon accidental circumstances. These are the gelatinoid, fibrous, granular, and vascular, which possess features sufficiently distinctive to entitle them to separate notice.

The *gelatinoid* polyp, the most common of all this class of morbid growths rarely occurs in any other situation than the nose; it is, however, occasionally observed in the ear, larynx, vagina, and certain portions of the alimentary tube. As its name implies, it is of jelly-like appearance, looking, indeed very much like an oyster, being of a soft, spongy consistence, and generally of an irregularly pyriform shape, with a narrow pedicle, sometimes nearly an inch in length. Occurring either singly or in clusters, it often completely closes the cavity in which it grows, although it rarely acquires much bulk is destitute of sensibility; readily breaks under pressure; and is remarkably hygrometric, expanding in wet weather, and shrinking in dry. When pricked a thin yellowish and slightly coagulable fluid exudes, which under the microscope shows nucleated cells lying in a transparent blastema. The growth consists essentially of cellular substance supported by mucous membrane—a reflection from that of the part to which it is attached—and is nourished by a few straggling vessels, which are often of considerable length and thickness. When extirpated it is remarkably apt to be reproduced.

The *fibrous* polyp owes its name to the peculiarity of its structure, which is of a dense firm character, the fibres interlacing with each other in every possible manner. In the recent state it is of a reddish, purple, or livid hue but after maceration for a short time it exhibits a pale grayish aspect, and then displays its characteristic fibrous arrangement to great advantage. I is usually exceedingly tough, hard, and incompressible, offering great resistance to the knife, which emits a creaking noise as it is drawn through its substance. Although it has seemingly very few vessels, its removal is frequently attended with copious hemorrhage, both arterial and venous. Being nearly always solitary, it generally grows quite rapidly, often attaining a large bulk in a short time, and is usually attached by a broad base, not by a narrow pedicle, as is the case with the gelatinoid polyp. The most common habitations of this growth are the uterus, nose, and maxillary sinus. When extirpated, it has a tendency to recur; and cases are not wanting where it manifests a malignant disposition.

The *granular* polyp, found chiefly in the uterus and nasal fossa, is, on the whole, very uncommon, and seldom attains any great bulk. It is of a pale rose-color, grayish, or whitish; of a soft, fragile consistence; globular, ovoidal, or conical in shape: and from the size of a currant to that of a grape, its connection being usually effected by a long slender pedicle. Its structure is granular, homogeneous, and inelastic looking, when cut, somewhat like a macerated salivary gland, and containing a small quantity of serous fluid. It has few vessels, grows slowly, and is easily detached, sometimes reappearing after extirpation.

The *vascular* polyp, occurring mostly in the ear, nose, uterus and rectum, is of a florid color, soft and spongy in its consistence, and usually attached by a narrow base. A section of it displays a cellular structure pervaded by numerous vessels, none of which, however, are of much volume, but still sufficiently large to produce copious hemorrhage when accidentally opened. The tumor, in fact, possesses many of the properties of the erectile tissue. Notwithstanding this, it seldom attains much bulk, and is generally slow in its progress, with little disposition to recurrence after removal.

We are hardly sufficiently familiar with the structure and functions of polypoid tumors to enable us to explain their origin. The probability is that most, if not all, take their rise in a species of hypertrophy of the tissues with which they are connected and from which they grow. Thus, the granular polyp apparently always begins in the mucous follicles of the part, which, as it expands, inveigles other structures, which thus serve to impart to it its distinctive features. In the vascular variety, the vascular element predominates, in the gelatinoid, the cellular, and in the hard, the fibrous. Whoever has examined a fibrous polyp of the uterus must have been struck with its firm adhesions to that organ, and the perfect identification of its substance with that of the parenchymatous structure. Dr. Da Costa informs me that he has often found, in addition to fibrous tissue, muscular fibres and fibre-cells in this species of womb growth, rendering it thus highly probable that the fibrous polyp of this viscus is merely a species of hypertrophy of its proper substance. In the nasal fossa it is probable that this form of tumor always originates in the periosteum; at any rate, such a conclusion is plausible when we recollect that it is usually attached by a very broad base to the floor or septum of the nose.

These morbid growths are liable to various transformations, especially the fibrous, fibro-cartilaginous, cartilaginous and osseous; a circumstance which has induced some writers to make these changes the bases of so many additional divisions of these morbid products. They are, however, altogether accidental, and are seldom found except in cases of long standing. A more serious occurrence is the supervention of carcinomatous disease, if we concede the possibility that a structure, originally benign, may, during its march, take on malignant action. Without altogether denying such an occurrence, it must, to say the least, be extremely rare, and it would perhaps be more rational to conclude, in the absence of positive facts, that the tumor in most cases was primitively of a cancerous character, than that it became so during its progress. The fibrous polyp is more liable to this kind of degeneration or assumption than any other.

All polypoid tumors act obstructingly, closing the cavities in which they are developed, and thus interfering with the exercise of their functions. As they augment in size, they encroach upon the surrounding structures, pressing them out of shape, and causing more or less serious deformity. In this way, moreover, they may be productive of severe pain and great increase of the natural discharge of the part. In the nose and uterus they often give rise to serious hemorrhage.

The period of life at which these bodies appear varies according to circumstances. In the uterus they are most common in elderly females; in the nose, in young adults; in the rectum, in children; in the larynx, in advanced life.

No medical treatment of which we have any knowledge is of any avail in getting rid of these tumors. Sorbefacients, whether employed externally or internally, or both, are utterly useless. The only reliable remedy is extirpation, a proceeding which, if properly executed, rarely fails to afford at least temporary, if not permanent relief. In performing the operation it is important to effect complete clearance, since, if the least germ of the morbid product be left behind, repullulation will almost be inevitable. As it is, even with the best possible care, it is very difficult, especially in the gelatinoid variety of the affection, to prevent this occurrence. The methods of operation are torsion, ligation, and excision, of which the first should generally be preferred, as the least likely to cause suffering and hemorrhage. These procedures will be described in connection with polypoid tumors of different parts of the body.

13. MYELOID TUMORS.

The name of this tumor, which literally signifies marrow-like, was given to it by Mr. Paget, although its structure had been previously described by Lebert. It has been noticed in different parts of the body, but in particular in or upon bone, the mammary gland, uterus, cerebral membranes, the subcutaneous cellular tissue, and in the eyelids and conjunctiva, occurring in various sized masses, generally of a rounded, or ovoidal shape, and of a consistence varying from that of tallow or suet to that of fibro-plastic tissue. The cut surface has a smooth, compact, shining appearance, with blotches of a dark crimson, brownish, pink, or modena hue, either uniformly, or in various degrees of combination, all these tints being sometimes commingled. Much stress is laid upon these colors by pathologists as diagnostic characters of myeloid tumors, affording, as they do, the most ready external means of discrimination between them and other analogous formations.

A considerable quantity of fibrous, cellulo-fibrous, or fibro-plastic matter, generally enters into the morbid growth, presenting itself in the form of whitish, grayish, or yellowish filaments, scattered about irregularly, and frequently so arranged as to intercept small cells, filled with serum, sanguinolent fluid, or pure blood. Sometimes large cysts occur, similar to those which we find in tumors of the thyroid gland, and occupied by similar liquids. In the more recent specimens a section of the mass generally furnishes, on pressure, a small quantity of a thin yellowish fluid, altogether different from cancer-juice. When the disease is developed in the cancellous tissue of the bones, where its occurrence is more frequent than elsewhere, the tumor disparts the compact layers, forming a kind of cyst-like expansion, in which the new matter is lodged, and which, under such circumstances, often contains a large amount of osseous substance, soft, cellulated, of a reddish or pale yellowish tint, and easily recognized by sight and touch.

The minute structure of the myeloid tumor essentially consists of cells, nuclei, and nucleoli, imbedded in a finely granular matrix, and interspersed with filaments of fibro-cellular tissue. More or less fatty substance is frequently present, and the stroma is usually very vascular; a circumstance which readily explains the rapid development of this variety of morbid growth. Of the cells, as described by Paget, some are small, and of an oval, lanceolate, angular, or elongated figure, their contents being dimly dotted with single nuclei and nucleoli; others are round, oval, or flask-shaped, measuring from $\frac{1}{300}$ to $\frac{1}{1000}$ of an inch in diameter, and occupied each by nearly a dozen nucleolated nuclei. Intermingled with these corpuscles are free nuclei, of various forms and sizes, giving evidence of having escaped from the older cells.

The myeloid tumor is generally rather rapid in its growth, occurs in both sexes and at different periods of life, but more commonly in the young and middle aged than in the old, and is capable of attaining a considerable bulk. From its tendency to destroy effectually the structures in which it is developed, and from the fact that it occasionally displays a malignant tendency, recurring after extirpation, and ultimately causing death, there is strong reason to conclude that it is generally merely a modified form of encephaloid or fibroplastic growth. Nevertheless, we are not warranted, in the existing state of the science, in expressing a very positive opinion regarding the true nature of the disease. Further observation alone can afford any valuable clue to this.

Myeloid tumors furnish no diagnostic signs. They generally grow more rapidly than any other class of tumors, except the encephaloid, but their real nature can never be positively determined until after their removal. Of their treatment, or the influence of remedies in checking or arresting their progress, we are equally ignorant. When connected with the bones of the extremities, nothing short of amputation will of course hold out any prospect of relief, and even this is commonly very remote and uncertain. If excision be determined upon, the knife should be freely carried through the sound tissues, so as to guard as much as possible against relapse.

EXCISION OF BENIGN TUMORS.

To the above account of benign tumors may be appended, by way of practical precept, a few remarks respecting the proper method of removing these morbid growths with the knife.

1st. Interference should, as a general rule, be avoided when the tumor is stationary, or nearly so, painless, and not inconvenient by its size or situation.

2dly. If an operation be determined upon, the system should always be subjected to a certain degree of preliminary treatment, even when the tumor is comparatively small, experience having shown that extirpation is often followed by erysipelas.

3dly. While the object should be to effect the most thorough removal, care should be taken not to interfere unnecessarily with the surrounding tissues, but to respect them as much as possible by keeping the knife in close contact with the morbid growth.

4thly. If the tumor be of unusual bulk, it will generally be necessary to remove a portion of its tegumental covering, making, for this purpose, an elliptical incision; otherwise all the skin should be retained, due allowance being always made for its astonishing contractile powers. If this precaution be neglected, there may be a deficiency of flap when the surgeon comes to approximate the edges of the wound.

5thly. Diseased integument should always be removed along with the morbid growth.

6thly. In general, extirpation may be effected by a single incision carried across the centre of the tumor, either vertically, or in a curvilinear direction. It is only when, as already stated, the morbid growth is very large, that an elliptical incision will be required.

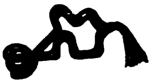
7thly. Care should be taken, in making the incisions, to give them such a direction as shall favor drainage, or prevent bagging. Hence, one of the extremities should always correspond with the most dependent portion of the tumor.

8thly. By keeping the knife in close contact with the tumor, it may sometimes be promptly and effectually enucleated with the hand, finger, or scalpel. Another advantage resulting from the observance of this precaution will be the avoidance of hemorrhage.

This book is the p
COOPER MEDICAL

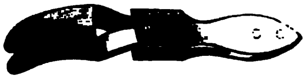
9thly. Any large arteries that may be divided should either be compressed by an assistant until the extirpation is completed, or they should immediately be tied, loss of blood being carefully guarded against in all proceedings of this kind. When the surgeon is operating alone, or when he has no good assistants, the bleeding may be temporarily checked with the serrefine, fig. 40, a kind of wire forceps, or the contrivance depicted in fig. 41. These instruments hold on by their own elasticity, and will be found of great service in extensive and tedious dissections, especially when it is necessary to cut the same artery several times.

Fig. 40.



Serrefine.

Fig. 41.



Small forceps for temporarily checking hemorrhage.

10thly. When all oozing of blood has ceased, the edges of the wound are accurately approximated by suture and adhesive strips, aided, if necessary, by a light compress and bandage, to keep the flaps in close contact with the raw surface beneath; the object being to secure union by the first intention.

11thly. The part is always to be kept perfectly at rest until the wound is healed; the case being treated in every respect upon ordinary antiphlogistic principles. In general, the dressings should not be disturbed before the end of the third day, especially if the absence of fetor and discharge indicates that everything is progressing favorably.

SECT. III.—MALIGNANT TUMORS.

Under the term malignant are comprised certain morbid products which have the effect, within a variable period after their formation, of destroying not only the tissues in which they are deposited, but also the life of the patient. The pathological anatomist usually describes them under the name of the heterologous, heteroclite, or heteromorphous products, in reference to their want of similarity to the natural structures, but the prefix malignant is justly applicable to them, on account of their destructive disposition. The formations which are usually embraced under the present head are scirrhus, encephaloid, colloid, melanosis, and cancroid, the latter having been only lately added to the list as a distinct affection. From this catalogue tubercle is usually excluded, although it is by far the most common as well as the most destructive of all the heteromorphous developments, especially when it occurs in the lungs and serous membranes. In the external parts of the body, however, it is less so, and hence, perhaps, the reason why surgical writers generally exclude it from this position. It would greatly simplify the study of these affections if the term "cancer," by which some of them continue to be designated, were altogether discarded from surgical nomenclature. This expression, introduced in the infancy of the science, is entirely figurative, and therefore calculated to mislead the mind of the inquirer.

Of the extensive prevalence of cancerous disease some idea may be formed when it is stated that, in five years, namely, from 1838 to 1842, inclusive, 11,662 persons died of it in England alone, independently of the cases which occurred in London. Of these cases, 8,746 occurred among women, and 2,916 among men, or in the ratio almost of three to one. This difference is due to the extraordinary frequency of carcinoma of the uterus and mammæ, particularly the former, which suffers nearly as often as all the other organs together.

These various morbid formations, although they differ widely in many of their characters, yet possess certain features in common with each other, which may be briefly enumerated before we proceed to speak of them individually.

1st. They are all deficient in plastic material, while they contain an unusual amount of albuminous substance, or the protein principles of the blood. The consequence is that they are less organizable than the ordinary lymph-products, and also less capable of maintaining a long existence in the parts among which they are deposited.

2dly. Under the microscope they are found to consist of two parts, a fibrous stroma, and granules or cells, which bear to each other the relation of containing and contained parts. The former is either of new formation, or it is composed of pre-existing tissue, in an altered state. The cells often contain nuclei and nucleoli, and possess, in many cases, an astonishing multiplying faculty; a circumstance which adds greatly to the rapidity and malignancy of the morbid growth.

3dly. They occur in nearly all the organs and tissues of the body, in both sexes, at all periods of life, in all temperaments, and in persons of all occupations, often existing simultaneously in a number of localities. They frequently display a marked hereditary tendency, forming at or soon after birth, and also a disposition to appear in several members of the same family.

4thly. They present themselves under different varieties of form; generally as a distinct, circumscribed tumor, but very frequently also as a stratum, or infiltration.

5thly. They are all deposited, as a secretion, in a fluid form, but soon assume a concrete character, which, after a time, they again, in part, lose, their tendency being to become disintegrated, and to work their way to the surface, by exciting ulcerative action in the surrounding tissues. The resulting sore is incapable of forming healthy matter and healthy granulations; or, in other words, it remains open and intractable, either for an indefinite period, or until the patient perishes from the effects of the local and constitutional irritation.

6thly. They are all of constitutional origin, or connected with a contaminated state of the blood and solids, a perfectly healthy individual being incapable of their attack, which generally takes place without any assignable cause. Owing to this circumstance, they always manifest a tendency to reappear after extirpation, either at the original site, or at some other point.

7thly. Their progress is generally rapid, most of them causing death in from nine to eighteen months from the time of their first appearance. As they advance, especially when ulceration is about to begin, they involve the neighboring lymphatic ganglions, transmitting to them, through the agency of the absorbents, some of their own material, or exciting similar disease by sympathetic irritation.

The so-called cancer-cells have been, and still are, a prolific source of disputation. While there are some who altogether deny their existence, as a distinct and specific entity, the great majority of pathologists agree in the opinion that they are peculiar to this class of morbid growths, and they do not hesitate therefore to assign to them an important histiological and diagnostic rank. Without attempting to decide a question of such grave importance, for which our knowledge is perhaps still too imperfect, it may confidently be assumed that all carcinomatous formations are intimately connected with, if not directly dependent upon, the presence of cells, of a more or less complex structure, which thus influence their development, and serve to impart to them their distinctive features. Time will probably show whether these cells are new cells, or merely cells which naturally exist in all organs and tissues, in a state of disease, alteration, or degeneration.

The accompanying sketches, from Beal and Druitt, will serve to co good idea, in a general point of view, of the nature of these cells, and o disposition in the fibrous stroma, or basement-structure, above allude(

Fig. 42.

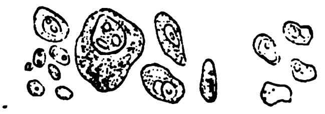


Fig. 43.

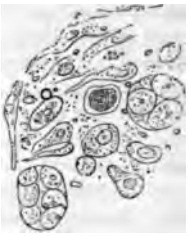


Fig. 42 represents cells in the earlier stages of carcinoma, with nu *a*; magnified 200 diameters. In fig. 43, the cells, termed mother-ce older and larger, or, in other words, further advanced in their develo|

Fig. 44.

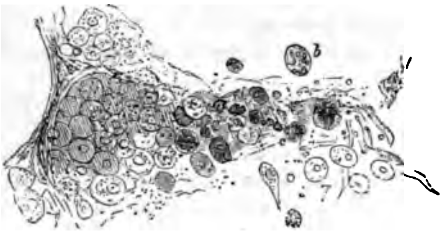


Fig. 44 exhibits the cells ε lie in their fibrous stroma some of the cells are loade fat, and others with me pigment, unmistakable evi of increasing age and g decay.

In its shape the cancer· pretty regularly spherica about the $\frac{1}{1000}$ of an i diameter, with an oval, ec nucleus, situated in its iı and generally occupied l or more nucleoli. These arrangements may be rendered particularly c if the matter under examination be treated with acetic acid, which mal cell pale and transparent, and brings out the nucleus in bold relief. I varieties of carcinoma, the cell frequently exhibits a caudate configura

The occurrence of ulceration in cancer is a direct consequence changes wrought by age and disease in the cancer-cells. As the ı growth progresses, the cells become opaque, irregular, flattened oı pressed, and infiltrated with oil and different kinds of pigmentary subs They undergo, in fact, changes very similar to those which are witne lymph or plasma. As a general rule, it may be stated that the large most perfect cells are found in scirrhus or hard cancer, especially in tl slow growth. The more imperfect cells are seen in encephaloid and rapidly developing forms of the disease.

1. SCIRRHUS.

The term scirrhus is employed to designate a morbid product which dense and firm than any of the natural tissues, excepting tendon, ca and bone. Hence it is often called hard cancer, an expression whi applied to this substance in the infancy of the science, from some fanc semblance which it was supposed to bear to the claws of that animal. to be regretted, as already stated, that it is not altogether abolishe surgical nomenclature, as its retention is only calculated to add confu a subject unfortunately sufficiently obscure.

The occurrence of scirrhus is as frequent as its character is maligna unforgiving. It is observed at various periods of life, but rarely until after middle age. The youngest subject in which I have ever seen the disease was a mulatto child three months old, whose case has been reported by Dr. S. W. Gross, in the North American Medico-Chirurgical Review for May, 1857. It presented itself in the liver, which was otherwise perfectly healthy, in the form of white tubercles, which were of a firm, almost fibro-cartilaginous consistence, and exhibited under the microscope all the characteristics of genuine scirrhus. Scirrhus of the skin is also occasionally observed at a comparatively early period; but everywhere else it is rare until after the age of forty, when it becomes sufficiently common. The period of its greatest frequency is from the forty-fifth to the fifty-fifth year.

Females are more liable to scirrhus than males, but in what precise proportion has not been ascertained. The influence of temperament, habit, and occupation upon the production of the disease also remains undetermined. It is generally supposed that persons of a dark bilious temperament are particularly subject to it, but for such an opinion there is no valid reason.

Certain organs and tissues are more prone to scirrhus than others. Thus, what are called the glandular viscera, as the liver, mamma, and uterus, are particularly liable to suffer, though the testicle, which belongs to the same class, is singularly exempt from the disease, so much so, indeed, that we may well question whether it is ever attacked by it. The stomach, anus, rectum, and colon are often invaded in both sexes. Scirrhus was supposed at one time to be very common in the lip and penis, but recent researches tend to show that this is not the fact, but that the affection, formerly so regarded, is nothing but epithelial cancer, a milder form of malignant structure. Whether this, however, is really so, future observation must decide. Meanwhile, it is positively certain that cancroid disease is often much more rapidly fatal than scirrhous. The bones, muscles, tendons, ligaments, aponeuroses, vessels, nerves, salivary glands, brain, lungs, spleen, and urinary organs are nearly entirely exempt from this heterologous formation.

Like the other heteromorphous products, the scirrhous may appear under several *varieties* of form, as the tuberoid, stratiform, and infiltrated, of which the first is the one, surgically speaking, of the greatest interest. The other two occur chiefly in the internal organs, particularly the œsophagus, stomach, colon, and rectum, the submucous cellular tissue of which they often so completely transform as not to leave a vestige of the original structure; at the same time that they encroach very seriously, if not fatally, upon the caliber of the tube. The affected part is dense and crisp, cutting almost like fibro-cartilage, and has a pale yellowish or grayish appearance, with white fibrinous intersections. The stratiform variety is occasionally met with in the skin and subserous cellular tissue, but the occurrence is uncommon. Scirrhus of the uterus generally presents itself as an infiltration.

The best example of the tuberoid variety occurs in the mamma and liver; it is also sometimes seen upon the serous membranes and in the skin, or in the skin and subcutaneous cellular tissue, in the form of little nodules, often not larger than a currant, a pea, or a filbert. Sometimes the tumor consists of one single mass, as in the liver, but more generally it is made up of several, which together may form a growth as large as an orange, or even a fist, hard, dense, inelastic, and almost incompressible, grating under the knife, of variable shape, but generally globular or ovoidal, movable, and deeply inlaid in the tissues among which it is situated. These tissues occasionally afford the tumor an imperfect capsule, but in general there is no such investment, the heteroclite matter being often spread out in the most irregular and grotesque manner, like the claws of the animal from which the disease has derived its generic name. The fibrous intersections which pervade the interior of the morbid mass are the remains of the normal tissues, variously changed by the disease. They are generally of a dense, firm consistence, and of a grayish, bluish, or rosaceous color, thus strikingly contrasting with the abnormal deposit. It is questionable whether the fibrous bands, as they are commonly called, are ever entirely of new formation. In the mammary gland they generally consist of imprisoned lactiferous tubes.

Structure.—A section of a scirrhous tumor, especially in its more matured stages, exhibits a whitish, homogeneous aspect, and affords, upon being scraped, a peculiar lactescent fluid, somewhat unctuous to the touch, which has received the name of *cancer-juice,* and upon which much stress has been laid by modern pathologists as denotive of malignancy. It is seldom present in very recent specimens, and my researches have led me to believe that it is a result of partial softening of the heteromorphous mass, preparatory to ulceration. We sometimes find it united with a considerable quantity of free oil.

Scirrhus has a very feeble circulation, its vessels being remarkably small, and probably wholly derived from the surrounding parts. Of their precise arrangement, however, we have no definite idea. The paucity of vessels affords a satisfactory clue to the slow growth and comparatively small size of the morbid product, and a reason, also, why there is so seldom any considerable hemorrhage after ulceration has set in. No nerves have been demonstrated in its substance, but their free distribution is inferred from the sharp, lancinating pain which forms so characteristic a symptom of the disease. Lymphatics also exist; as is proved by the fact that if arsenic be applied to an open scirrhous ulcer, it is often absorbed into the system, producing similar effects as when taken directly into the stomach.

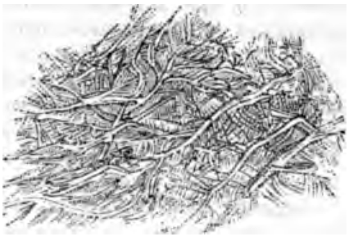
Pathologists have laid much stress upon the existence of certain subdivisions of scirrhous tumors, as the mammary, pancreatic, lardaceous, and reticular, as if the appearances which these expressions are intended to designate were not purely accidental, depending upon the character and amount of pre-existing tissue, the age and mode of aggregation of the heteroclite matter, and above all, the state of the patient's general health. I must object the more strenuously against the use of these terms, because they have only a tendency to complicate the subject and create confusion. I am sure that, with all my opportunities for observation, I have never seen a scirrhous tumor to which the word mammary or pancreatic could be applied with any degree of propriety; and it is equally certain that the lardaceous and reticular varieties, as they have been termed, although they may sometimes present a faint resemblance to the objects after which they have been named, must be exceedingly rare.

Chemically examined, scirrhus is found to consist largely of albumen and fatty matter, the two together forming more than one-half of the entire mass. In a specimen of scirrhus of the uterus, analyzed by Hecht, the fatty substance amounted to fifty per cent. Fibrin exists sparingly in all cases. Gelatine is said to be occasionally present, but this is questionable. In an examination by Foy, upwards of thirty per cent. of earthy salts existed, fully one-half of this quantity being in the form of subphosphate of lime.

The facts which chemistry has revealed in regard to the composition of scirrhus are valuable, as showing that this substance is formed of materials very much of a non-plastic character, and consequently incapable of resisting, for any length of time, the influence of surrounding agents. It is reasonable to suppose that its composition is not alike in all cases, but that it is greatly influenced by the site and age of the morbid product, and, therefore, that it varies not only in different stages of the malady, but also in different portions of the same specimen.

The *minute structure* of scirrhus consists of two parts, a fibrous network, and a soft granular matter. The former is made up of filaments, of a whitish or grayish color, which, intersecting each other in every conceivable direction, form meshes, of variable shape and size, for the lodgment of the granular element. These filaments, which are well shown in fig. 45, are of a fibrous structure and generally consist, not of new matter, but merely of pre-existing tissue, condensed and altered by the heteroclite deposit. Their appearance is occasionally very distinct in recent specimens of scirrhus, especially of the liver and mamma, but ordinarily it is necessary to scrape away the granular matter before they can be brought into full relief.

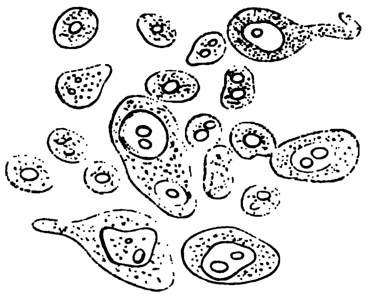
Fig. 45.



Stroma of scirrhus.

The essential element of scirrhus, contained in the meshes of the fibrous structure, consists mainly of cells and free nuclei, lying in a transparent and slightly granular matrix. The cells vary much in shape; some being round, some oval, and others, again, caudate, or furnished with tail-like prolongations. In size they range from the $\frac{1}{800}$ to the $\frac{1}{1700}$ of an inch in diameter, most of them being large and well defined, especially in the more matured specimens of the disease. They have each a delicate, but distinct wall, and generally inclose one or more nuclei. The nuclei are, for the most part, of an oval shape, and often, in turn, inclose well-marked nucleoli. Sometimes the nuclei escape from their cells, and scatter themselves through the uniting substance as if in search of new homes. Finally, crystals, granules, oil drops, and old, degenerated cells are often found in the same specimen under the field of the microscope. The various forms of cell-formation are well shown in fig. 46, from a drawing by Dr. Da Costa.

Fig. 46.



Cells of scirrhus.

Progress.—The progress of scirrhus is generally more slow than that of the other heteromorphous deposits, both as it respects its tendency to ulceration and the destruction of life. It is seldom that a scirrhous tumor of the breast becomes an open sore under twelve, fifteen, or eighteen months; not unfrequently, indeed, several years elapse before it takes on this kind of action. I had at my Clinic, two winters ago, an elderly lady, formerly a patient of Sir Astley Cooper, in whom the disease had been regularly progressing for more than twenty years before any disposition to ulceration became apparent. Several other cases, somewhat less in their duration, have been under my observation. In general, however, the tendency to ulceration shows itself within the second year, commencing usually in a superficial portion of the tumor, sometimes at one, and at other times at several points, the process being preceded and accompanied by more or less discoloration of the surface, and by the adhesion of the skin to the subjacent parts. The color is always dark, purple, or livid, the vessels immediately concerned in its production being enlarged and deeply congested, frequently presenting an appearance as if they were inlaid in the cutaneous tissues. The part at length giving way, an unsightly ulcer is exposed, having hard, steep, and rounded edges, and a foul-looking bottom, generally incrusted with spoiled lymph. The discharge is always of a sanious, ichorous, or sanguinolent nature, more or less fetid, irritating, and often remarkably profuse. It tarnishes silver, imparts a green color to syrup of violets, and, on admixture with sulphuric acid, evolves a peculiar gas, having many of the properties of sulphuretted hydrogen. No granulations ever form upon such an ulcer; hence it never heals, the plastic matter which it secretes losing its vitality as soon as it is deposited. There are, of course, exceptions to this rule; but they are very uncommon, and I have never met with any. Sometimes the scirrhous ulcer has a remarkably excavated appearance, as if it had been dug out with a punch. The parts immediately around the ulcer are always very tender, discolored, and œdematous.

Another tendency of the scirrhous tumor is to contract adhesions to the structures among which it is situated. This disposition, which often manifests itself at a comparatively early period, is always very conspicuous in the latter stages of the malady. The immediate cause of the adhesions is an effusion of ordinary plastic matter; but in some cases, especially in such as are of long standing and of unusual size, they are owing, at least in part, to the heteromorphous deposit itself, which, under such circumstances, often breaks through its original boundaries into the skin, cellulo-adipose tissue, muscles, glands, and even bones, involving them all in one common mass.

But a tumor of this kind not only involves the parts with which it lies in immediate contact, but it often extends its influence to others further off. The structures which are most liable to suffer in this way are the lymphatic ganglions, which often take on the same kind of action, becoming enlarged and indurated, and exhibiting, on division, precisely the same appearances as the original tumor. Sometimes, again, parts still more remote become involved in the morbid action. Thus, in scirrhus of the mamma we often see not only great contamination of the axillary lymphatic ganglions, but serious swelling of the corresponding arm, evidently from an extension of the primitive affection.

Thus the tendency of this disease is to spread and to contaminate the surrounding structures, making itself deeply felt not only at home but abroad; not merely locally but constitutionally. In exceptional cases, the morbid influence is closely circumscribed, limiting itself, perhaps, for years, to the spot in which it originally appeared; but even then it eventually breaks through its barriers, and spreads among the surrounding parts. Finally, after having inhabited the part for a time, nature occasionally makes an effort at extrusion, the tumor being invaded by gangrene, and at length detached as a slough. Such an occurrence, however, is extremely rare. I have seen but one instance of it. The patient was an elderly lady, fat, and otherwise healthy, who had a medium-sized scirrhus tumor in one of the mammary glands which had troubled her for several years. All of a sudden, without any assignable cause, inflammation set in, and in a few weeks the whole mass was lifted from its bed as neatly as if the operation had been performed with the knife. Some time afterwards the disease broke out in the axillary lymphatic ganglions, and made rapid strides towards a fatal termination.

Symptoms.—The symptoms of scirrhus necessarily resolve themselves into local and constitutional. The former can only be satisfactorily studied as they appear in an external tumor, such, for example, as that which involves the mamma. In taking hold of such a tumor we are struck with its extraordinary hardness and density; it feels firm, incompressible, and inelastic. If it be of recent origin, it will be found to be perfectly circumscribed and movable, the examiner being able to grasp it with the fingers, and to push it about beneath the skin; at a later period, however, it contracts adhesions to the surrounding parts, and thus becomes firmly fixed in its situation. The morbid product may appear as a solitary tumor, or several little lumps may appear simultaneously or successively, and, gradually coalescing, a considerable sized mass may thus be formed.

The pain of scirrhus is peculiar. It is sharp and lancinating, darting through the parts like an electric spark, or causing a sensation as if needles were thrust into them. It makes its appearance at an early date, gradually increasing in severity, and becoming at length a source of intense suffering. It may be steady and persistent, but more generally it is intermittent, coming and going apparently as whim or caprice may dictate. It is always aggravated by damp states of the atmosphere, and by whatever has a tendency to impair the general health. In some cases we find it to be of a neuralgic character; and under such circumstances, instead of being limited to the morbid mass, it often shoots about in different directions among the neighboring structures. During the latter stages of the disease it is generally so constant and violent as to deprive the patient of sleep and appetite, thus rapidly urging on the fatal issue.

During the progress of the disease the skin is tied down to the morbid mass, and soon becomes hard and livid, its vessels being at the same time very much enlarged and deeply congested. Presently ulceration sets in, the resulting sore having a steep excavated appearance and a foul discharge, without the ability to form granulations, to produce healthy pus, or to undergo reparation. The tumor is now firmly adherent to the surrounding structures, and there is generally, though not invariably, lymphatic involvement. A discharge of blood sometimes attends the ulcerative stage, but it seldom exceeds a few drachms, or, at most, a few ounces. The bleeding may be purely capillary, or it may proceed from a tolerably large vessel, arterial or venous, laid open by the morbid action, and unable to retract in consequence of the condensation of the circumjacent tissues.

Scirrhus in its earlier stages, produces little or no constitutional disturbance. The affection is strictly local, annoying and fretting the parts directly involved in it, but not awakening any general sympathies. A little mental disquietude, the result of the consciousness that there is a suspicious tumor or lump, is the only thing that excites attention. By and by, however, the health begins to fail; the appetite is impaired; the sleep is interrupted by the severity and frequency of the pain; the secretions are disordered, and some of them are, perhaps, entirely suppressed; the bowels are irregular; the assimilative functions suffer; occasional attacks of fever take place; the flesh and strength gradually decline; the spirits are depressed; and life is beset on every side by the treacherous and unrelenting enemy. During the latter stages of the malady, sometimes even before there is any serious lymphatic involvement, the countenance assumes a peculiar sallow, cadaverous expression, so denotive of the cancerous cachexy; diarrhœa and sweats set in; the limbs become anasarcous; and at length the patient dies utterly exhausted, being literally pricked, fretted, and stung to death by the disease.

During the progress of this disease scirrhous deposits often appear in other parts of the body; the blood becomes thin and colorless; and the solids are emaciated, pale, and flabby. Even the bones often experience important changes, especially those of the thigh, which are sometimes rendered so fragile as to give way from the slightest cause. Many years ago I had under my charge, on account of scirrhus of the mamma, an old lady of seventy-three, who broke her right femur a few days before she died, simply by turning round in bed.

2. ENCEPHALOID.

Although encephaloid and scirrhus closely resemble each other in their structure and composition, yet they exhibit sufficiently distinctive features to justify us in considering them as different diseases. As the progress of morbid anatomy advances, we shall doubtless become more enlightened in regard to their intimate relations, and also in regard to the relations which they sustain towards the tissues in which they occur, as well as to the system at large.

Encephaloid has various synonymes, of which the most common are, soft cancer, medullary sarcoma, cerebriform cancer, and fungus hematodes. Mr. John Burns, of Glasgow, who was the first to describe it, gave it the name of spongoid inflammation. All these various appellations have reference either to the appearance, consistence, or structure of the morbid product, and are, therefore, more or less appropriate. That of encephaloid, however, is, on the whole, the least objectionable, and is the only one that ought to be retained. There is a form of the disease, to which attention was first called by Mr. Hey, of Leeds, under the name of fungus hematodes, which I shall designate as the hematoid variety, and which, in my judgment, is the only one that deserves separate consideration. The terms solanoid, napiform, and reticulated, devised by some of the French and German pathologists, to specify particular states of encephaloid, ought to be discarded from the nomenclature of the disease, as they are only calculated to lead to confusion by keeping up a refinement which does not exist in nature.

The disease is more common in the mamma, eye, testicle, uterus, liver, lymphatic ganglions, periosteum and bones, than anywhere else. With the exception, however, of the muscles, tendons, nerves, cartilages, ligaments, and aponeuroses, there is no part of the body in which it has not been observed. Occasionally it takes place, either simultaneously or successively, in a considerable number of structures, resembling, in this respect, the other heteromorphous products, and constituting a genuine encephaloid diathesis. It appears in both sexes, and at all periods of life, from early infancy to old age, but the greatest number of cases occur between the twentieth and fiftieth year. The subjoined table, constructed for me by Dr. Cassot, shows the age in ninety-one cases.

Years.	No. of cases.
1 to 3	8
3 " 7	4
7 " 14	5
14 " 21	9
21 " 30	20
30 to 40	14
40 " 50	18
50 " 60	7
60 " 70	4
70 " 75	2

The *localization* of encephaloid is materially influenced by the age of the patient. Thus, in the mamma the disease is almost peculiar to middle age; in the testicle, to young adults; in the eye, to childhood. Of the relative frequency of the disease in the two sexes, we have no reliable data. In the cases analyzed by Dr. Cassot, there was a predominance of males, and in my own practice I have certainly seen it oftener in men than in women; but this may have been a mere coincidence.

The *chemical* composition of encephaloid, as determined by the analysis of Foy, probably the most accurate that has yet been made, shows the greatest possible resemblance to that of scirrhus by the same chemist. To enable the reader to compare the results of his examinations I shall subjoin his two tables in parallel columns:—

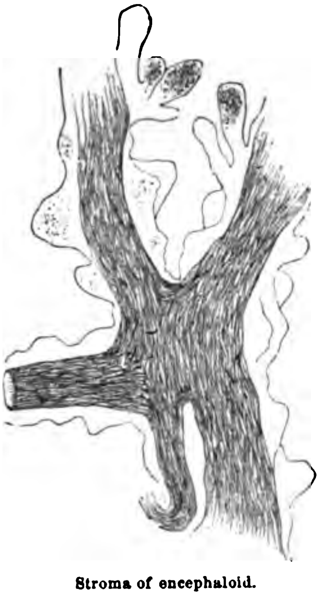
ENCEPHALOID.		
Albumen		47.00
White fatty matter		7.50
Red fatty matter		5.35
Osmazome		4.00
Fibrin		6.50
Water		8.00
Oxide of iron		1.35
Sub-phosphate of lime		6.30
Carbonates of	Soda	2.75
	Lime	4.00
	Magnesia	1.00
Hydrochlorates of	Potassa	2.70
	Soda	2.00
Tartrate of soda		0.35
		100.00

SCIRRHUS.		
Albumen		42.00
White fatty matter		5.00
Red fatty matter		3.25
Fibrin		5.85
Water		5.00
Oxide of iron		1.65
Sub-phosphate of lime		16.60
Carbonates of	Soda	5.00
	Lime	6.60
	Magnesia	0.85
Hydrochlorates of	Potassa	4.10
	Soda	3.25
Tartrate of soda		0 85
		100.00

It will thus be perceived that the chief differences in the composition of the two substances consist in the presence of osmazome in encephaloid, in the lesser quantity of earthy salts, and the greater quantity of albumen. The fibrin exists in nearly equal proportions. The analyses make no mention of gelatine, which has been asserted by certain chemists to exist in both substances, especially in the more recent specimens. Doubtless the composition of encephaloid is greatly influenced by the age and site of the deposit, the general health of the patient, the condition of the blood, and even by different portions of the same tumor.

The similarity of the minute *structure* of the two products is hardly less remarkable than that of their chemical constitution. Most specimens exhibit, under the microscope, a stroma and corpuscles, closely resembling those of scirrhus. The stroma, or basis-structure, exhibited in fig. 47, is made up of a fibrous substance, not equally well developed in every specimen, but in general sufficiently distinct to admit of easy recognition. The firmer varieties usually contain two kinds of fibres, both hollow, but one is opaque and granular, the other hyaline and studded with cells and nuclei. The other element, the essentially cancerous substance, consists of corpuscles, of a rounded, ovoidal, or caudate shape, exactly similar to those of scirrhus, only that the latter arrangement is commonly more distinctly marked. Nearly all include large, oval nuclei, and not a few also nucleoli. Besides these two substances, most specimens contain pigment matter, granules, and oil globules. The various forms of cancer corpuscles are well displayed in fig. 48. The caudate bodies are particularly distinct.

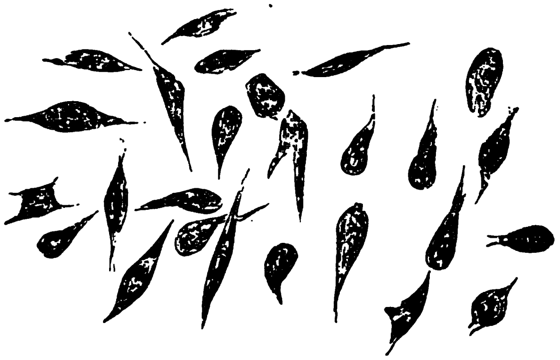
Fig. 47.



Stroma of encephaloid.

In regard to its arrangement, the encephaloid matter presents itself under three *varieties* of form, as a tumor, a stratum, and an infiltration, the first being the most common, and, surgically considered, the only one of any particular interest. It varies in volume from that of a pea to that of an adult's head, its shape being generally somewhat ovoidal, and its surface more or less lobulated as in fig. 48, from a specimen in my cabinet. Its config however, is always greatly influenced by the amount of pressure exerte

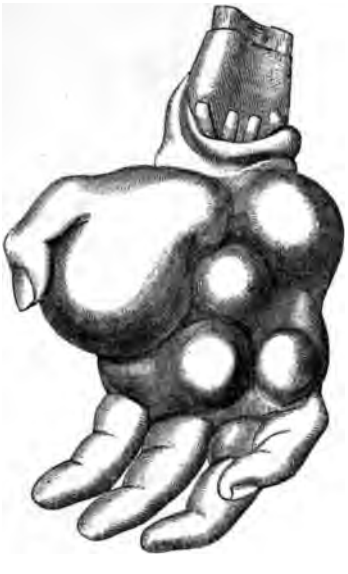
Fig. 48.



Elongated and caudate cells of encephaloid.

it by the parts in which it is situated, and hence it is occasionally ver flattened, or irregularly compressed. When seated in the external str as in the subcutaneous and interm cellular tissue, over the bones, in th mary gland, and in the lymphatic ga it has generally a well-marked cy grayish, whitish, or rosaceous ance, and of considerable firmn thickness, which thus serves to de limits and to isolate it from the textures. Extending from the in face of this envelope are numero cesses, which, passing through the of the diseased mass, intersect eac in various directions, and thus for cavities, or lodges, for the accomm of the new matter, just as in scirrh that they are generally larger an fully developed. The encephaloid freed from its stroma, or fibrous e is of a soft, jelly-like consistenc much like that of the fœtal brain to the touch, of a whitish or sligh dish tint, miscible with water, of a sperm-like odor, and readily coa by heat, alcohol, and acids, thus s its protein character.

Fig. 49.



Tuberoid form of encephaloid.

If a section be made of an e loid tumor, it will be found to in most cases, not a little variety of form, or diversity of appeara consistence. Thus, one part may be soft and white, like brain, anot haps feel, look, and cut like fibro-cartilage, while a third may be co essentially of a reddish semi-concrete substance, bearing a striking blance to the contents of an old aneurism. Most of these differen due to the age of the tumor, and the changes experienced by the i primitive tissues; but the latter are so distinct and peculiar as to entit to be considered almost as a separate formation. It is to this morbid product that, as was before stated, the term *hematoid* ought to be applied, as expressive of its blood-like structure. It looks, in fact, more like a mass of firmly coagulated and semi-organized blood than any other substance to which it can be compared. Occasionally a more solid substance is mixed up with the hematoid, as the fibrous, or fibro-cartilaginous, and when this is the case it generally creaks under the knife, cutting a good deal like a raw turnip, or the rind of bacon. I have found this form of tumor most commonly in the mamma, liver, testicle, and lymphatic ganglions, the latter of which, when thus affected, occasionally exhibit a singularly areolar structure, a section bearing a close resemblance to the surface of a sponge, the cells being occupied by the hematoid matter.

Encephaloid sometimes, although rarely, occurs as an infiltration chiefly in the lungs, liver, uterus, and lymphatic ganglions, the proper structure of which it subverts and ultimately completely effaces, forming a dense, solid mass, of a pink, grayish, or ash color, grating under the knife, inelastic, and almost incompressible. The stratiform variety is also uncommon. It is seen chiefly in the submucous cellular tissue of the stomach and rectum, and beneath the pleura and peritoneum, in small, thin, whitish patches, from the diameter of a dime to that of a dollar.

Encephaloid, being an extremely vascular structure, is endowed with a high degree of vitality, growing generally with great rapidity, and often attaining an uncommon bulk in a few months from its first appearance. Its vessels are unusually large, and are probably derived from the pre-existing tissues, although cases occur where the circumstances are such as to lead to the belief that they are now and then created, at least in part, by the heteroclite matter itself. If such a conclusion be admissible, as I think it is, it follows that encephaloid has occasionally, like plastic lymph, a double circulation, one peculiar to itself, and the other common to it and the tissues with which it lies in contact. Be this as it may, the vessels are generally remarkably voluminous, thus strikingly contrasting with those of scirrhus, at the same time that they afford a ready explanation of the differences in the rapidity and size of the two formations. Their walls also are unusually brittle, and hence they are liable to give way under the most trifling causes, producing those apoplectic depôts which we so often see in their interior, and those frightful hemorrhages which occasionally attend their open condition.

Of the absorbent vessels of encephaloid nothing special is known. Doubtless, however, they exist in large numbers, otherwise it would be difficult to account for the facility with which morphine and other articles, applied to encephaloid ulcers, find their way into the general system. Nerves are also probably freely distributed through the morbid mass, although it is a singular fact that this disease is generally much less painful than scirrhus. The reason, however, is not the paucity of nerves in the one, but the manner in which they are compressed in the other, the structure of encephaloid being so much softer than that of scirrhus, and therefore admitting of greater comfort to its nerves.

It is not unusual for encephaloid tumors to contain serous cysts, as well as other adventitious products, thus complicating their structure, and occasionally throwing a doubt over their diagnosis. In general, the cysts are small; but I recollect an instance where a cavity of this kind contained fully a pint of serum, its walls having a peculiar honey-combed appearance. Apoplectic depôts, as already stated, are most common in the hematoid variety of encephaloid tumors.

It is seldom that an encephaloid tumor, after having once taken a fair start, remains even temporarily stationary; on the contrary, its tendency is to proceed, steadily and regularly, in its work of disorganization, until it destroys life either by hemorrhage or by irritation, the period at which this takes place varying, on an average, from nine to twelve months. Death sometimes occurs in an almost incredibly short period. I remember the case of a youth of eighteen, a patient of Professor Post, in the New York Hospital, who had a large encephaloid tumor upon the scapula, measuring a foot in its greatest diameter, from which he died in less than eight weeks from its first appearance. On the other hand, a patient occasionally lives a long time. I am now attending a gentleman, aged forty-two, who has been laboring under encephaloid of the antrum for more than four years. Great softness of texture, bulk, and rapidity of growth are the circumstances which particularly predispose to an early unfavorable issue.

The period at which the encephaloid tumor becomes an open ulcer is indefinite; sometimes it takes place within a few months, at other times not under a year, or a year and a half, although this is uncommon. The immediate cause of the ulceration may be the pressure of the morbid mass upon the skin, the formation of an abscess, or the occurrence of a slough. However this may be, the sore is always characteristic. Its edges are thin, undermined, jagged, or irregular, and its bottom, which is sometimes of considerable depth, has a foul, bloody, fungous appearance. In some instances it is covered with numerous excrescences, or large fungous granulations, giving it a peculiar cauliflower-like aspect. The parts immediately around are of a deep red, livid, or purple color. The discharge is usually profuse, and of a sanious, bloody, or sanguinolent character, a development of pure laudable pus never being seen. Copious hemorrhage occasionally takes place, especially in the hematoid variety of the disease, and by its frequent repetition often rapidly undermines the general health, urging on the fatal crisis. The occurrence is particularly common in encephaloid of the eye, uterus, and mamma. Of the many cases that I have seen of the encephaloid ulcer, I have never known one to heal even temporarily. Intractability is one of its distinguishing features.

Lymphatic involvement often occurs at an early stage of the disease, sometimes long before ulceration sets in; at other times, however, it does not take place until the tumor has opened. As a general rule, it may be stated that the more rapid the growth is the earlier will there be disease in the neighboring ganglions, and conversely. The constitutional cachexy is always well marked in the more advanced stages of the affection, and the patient's doom is often depicted in legible characters upon his countenance several months before it is finally sealed in death.

An encephaloid tumor is distinguished by its comparative softness, by the rapidity of its growth, by its great bulk, and by its lobulated surface. The pain is generally slight, at least until ulceration takes place; and there is nearly always considerable, sometimes enormous, enlargement of the subcutaneous veins. In its earlier stages, the tumor is movable, as in scirrhus, but as it advances it contracts adhesions, and at length becomes permanently fixed.

3. EPITHELIOMA.

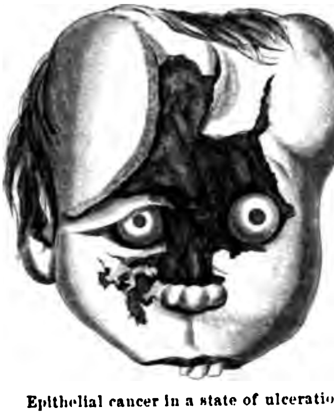
There is a class of affections which were formerly known under the name of scirrhus, from their supposed identity with that disease, but which modern research has shown to be so different from it as to entitle them to be regarded as separate formations. They comprise the various forms of malignant disease of the cutaneous and mucous tissues, more particularly carcinoma of the lip, gums, tongue, face, anus, and penis. They are not, however, limited to these parts; for they sometimes invade the deeper structures, as the bones, muscles, lymphatic ganglions, liver and lungs, although their occurrence here is very infrequent. The names by which these formations are now generally designated are epithelioma, cancroid, and epithelial cancer, which, as they are sufficiently expressive of their true character, may all be appropriately used as fancy may dictate.

Epithelioma is more common in men than in women, the latter being more liable to scirrhus. In the male the lip and penis are most frequently attacked. What is called chimney sweeper's cancer is merely a form of epithelial disease of the scrotum. Lupus, the *noli me tangere* of the older writers, is nothing but cancroid of the skin of the face, an affection sufficiently common in both sexes, and often committing the most frightful ravages. In whatever form it may appear, it seldom shows itself before the age of thirty-five or forty. Another circumstance worthy of note is that the disease usually occurs only in one part of the body, its origin being apparently much less connected with the constitution than that of the other varieties of carcinoma.

The *causes* of this disease are not well understood. Sometimes it is directly traceable to external injury, as long-continued pressure. Thus, Dr. Da Costa has mentioned to me the case of a shoemaker, where it was clearly attributable to the effects of a small board worn habitually upon the abdomen while the man was working at his trade. Epithelioma of the lip is often charged, whether correctly or not I will not pretend to determine, to the irritation produced by the pipe in smoking. Chimney sweeper's cancer is generally ascribed to the irritation occasioned by the lodgment of soot in the folds of the scrotum. Sometimes the disease originates in a wart or cicatrice. Epithelioma of the penis, until lately regarded as true cancer, has been very commonly referred to the irritation arising from a want of cleanliness due to the existence of a long and tight prepuce. A sharp tooth, brought constantly in contact with the tongue, is, as is supposed, an exciting cause of epithelioma of that organ. Cases have been collected which tend to prove that the disease occasionally manifests a hereditary predisposition. Dr. Foster, of Terre Coupee, Indiana, has communicated to me the particulars of three cases which occurred in three members of the same family, two having died from epithelioma of the face, and one from epithelioma of the foot.

Cancroid generally begins in the form of a tubercle, crack, or wart-like excrescence, hard to the touch, movable, and somewhat tender on pressure. As the disease advances the part extends in different directions, and becomes more defined in its character. By and by ulceration sets in, sometimes almost simultaneously at several points, the exposed surface having a foul, unhealthy, fungating appearance, with irregular granulated edges, and a hard, rough base. The discharge is generally abundant, and of a thin, sanious, acrid description, often eroding the skin in the neighborhood. The ulcer is intractable, manifesting no disposition to heal, or, if granulations should form, they speedily degenerate and lose their vitality, the recuperative powers being too feeble to carry on the work of repair. Once begun, the disintegrating action never stops, and hence its ravages are often most frightful, as, for example, in the case from which the adjoining cut, fig. 50, was copied, where the disease successively involved skin, muscle, bone, cartilage, and fibrous membrane, sparing nothing that fell in its way. The pain attend-

Fig. 50.



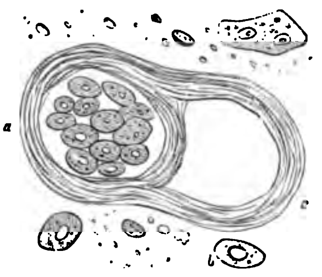
Epithelial cancer in a state of ulceration.

ing the disease is of a sharp, darting, or pricking nature, and often extends through the surrounding parts. Hemorrhage occasionally occurs, chiefly in the fungating form of epithelial ulcer, and may be sufficiently copious to cause serious debility. Cases have been observed where the disease laid open large-sized arteries and veins.

During the progress of the disease, lymphatic involvement occurs; sometimes early, but generally not until after the lapse of eight, twelve, or fifteen months. Thus, in epithelioma of the lip the ganglions of the jaw become enlarged, and in that of the penis the ganglions of the groin. The constitution also suffers severely, but usually not so early as in ordinary carcinoma, though ultimately not less fatally.

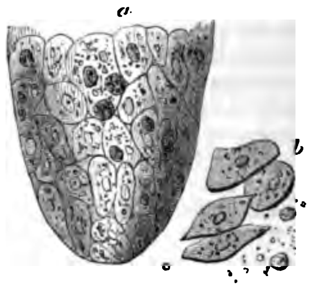
If a section be made of an epithelial cancer it will be found to grate under the knife, and to exhibit a firm whitish or grayish mass, more or less vascular, and of a radiating structure. In the lip and penis, it generally also contains well-marked papillæ, of varying size and shape, some being single, others united, which, however, are altogether adventitious, or they occur only in epithelioma of the mucous or muco-cutaneous surfaces. Minutely examined, the morbid growth is observed to consist mainly of cells not unlike those of pavement epithelium, only that they are larger. The cells vary considerably in their shape, some being rounded, some oval, and some fusiform, angular, or elongated. The older ones are sometimes flattened, shrivelled, or curled up, as if, partially deprived of vitality, they were about to become effete. They usually contain one or two small nuclei, and either lie in superimposed layers, united by fibrous matter, or they are inclosed in peculiar cysts, which are almost characteristic of this class of morbid products. These appearances are well seen in fig. 51, from a drawing by Dr. Da Costa. Sometimes these cells and nuclei are unusually large and distinct, strongly resembling such as occur in true carcinoma. Mixed up with the cells of epithelioma, especially if the disease has made some progress, are great numbers of free nuclei, and granules, and sometimes, also, of crystals of cholesterine, pigment cells, and blood corpuscles. The papillæ, previously alluded to, consist of loose fibrous tissue and bloodvessels very densely coated with layers of epithelial cells and free nuclei. Fig. 52 represents one taken from a cancroid affection of the lip. It will thus be perceived that the disease is deficient in some of the elements of ordinary cancer; a circumstance which accounts for its more manageable character.

Fig. 51.



a. Cyst including small cells; *b*. Large, rather round cells; *c* Empty cyst.

Fig. 52.



a. Papilla taken from an epithelial cancer, magnified 250 diameters; *b*. Separate epithelial cells

Epithelial cancer is generally comparatively tardy in its growth. In a case of cancer of the tongue, reported by Dr. Da Costa, in the Philadelphia Medical Examiner for April, 1852, twenty-two years elapsed from the appearance of the disease to the time of the operation for its removal. Cancer of the lip often lasts a number of years before it terminates fatally, though this is not its ordinary tendency, most persons dying in from eighteen months to two years. I have seen cases of lupus of the face continue their ravages for nine, fifteen, and twenty years before the disease finally caused death. Under such circumstances, the ulceration occasionally for a time suspends its action, and then resumes it, perhaps now with increased vigor.

4. COLLOID.

Since the attention of pathologists has been more closely directed to this affection, it has been found to be a good deal more frequent than was formerly imagined; nevertheless, compared with some of the other heterologous formations, it is sufficiently rare. The name by which it is usually known has reference to the peculiar jelly-like appearance of one of its principal constituents, and is therefore quite appropriate. It has also been described under the terms gelatiniform, alveolar, and gum cancer.

The favorite seats of this morbid product are the omentum, stomach, rectum, ovary, lower jaw, subcutaneous cellular tissue, and the bones of the extremities. The testicle, mamma, uterus, and lymphatic ganglions are also occasionally attacked by it. It has never been seen in the eye and its appendages.

It may occur simultaneously in a considerable number of organs, but manifests less tendency to general diffusion than any of the other heterologous formations, except the epithelial. It takes place in both sexes, and at all periods of life after puberty, but is most common between thirty-five and fifty. In two instances of enormous colloid tumors of the omentum, observed by myself, the patients were, respectively, forty and forty-nine. In a case which I noticed in the body of the sphenoid bone, beneath the dura mater, the age was thirty-nine.

Colloid occurs under two *varieties* of form, as a tumor, and as an infiltration. The latter is most common in the alimentary canal, particularly the stomach and rectum; the former, in the glandular organs, the peritoneum and omentum, ovary, cellular tissue, and the bones. In the bones it is most frequent in those affections known under the vague names of osteo-sarcoma and spina ventosa, which are sometimes almost exclusively composed of this substance. In the infiltrated variety of colloid, the new matter occupies the meshes of the cellular substance, forming cysts, from the size of a mustard-seed to that of a hazel-nut, which are filled with the characteristic jelly-like matter, and which, as they increase in volume and number, so completely subvert the primitive structures as ultimately to leave no trace of them.

In the other variety of colloid, the heteroclite matter occurs in the form of a distinct tumor, from the volume of a marble to that of an adult head, of a globular. rounded, or irregular shape, and of a firm, dense consistence. In the peritoneal cavity, I have seen, on two occasions, enormous tumors of this kind, one of which was supposed, by estimate, to weigh not less than twenty-five pounds. It extended from the pelvis to the diaphragm, surrounded the colon and part of the stomach, and almost completely concealed the abdominal viscera; its length being nearly one foot, its breadth upwards of eight inches, and its thickness from two and a half to three inches. The patient, aged forty-nine, had been laboring under the disease for four years. In the other case, that of a gentleman of forty, the tumor occupied the same situation, and was also of extraordinary extent. When the disease was first noticed, eight months before he died, the morbid mass was already of large size, forming an immense protuberance, which bore upon the walls of the abdomen in every direction, without causing the slightest inconvenience, save what resulted from its bulk.

The surface of the colloid tumor is generally rough, knobby, or distinctly lobulated, according to the volume and arrangement of the component cysts. Occasionally it bears a strong resemblance to the exterior of a pudding stone. The knife, as it passes through it, makes a creaking noise; it contains very little cellular substance, and the investing cyst is usually very thin. In the larger masses, considerable sized vessels may be seen running over the surface, and penetrating the walls of the principal cysts, without, however, passing through their contents.

Colloid consists of two component elements, a stroma, and the peculiar jelly-like matter from which the deposit derives its distinctive features. The former is of a fibrous character, and is arranged in such a manner as to form cells, loculi, or cavities, from the size of a pin head up to that of a small marble, rounded, ovoidal, or angular; communicating with each other, and lined by a thin, delicate, transparent membrane, which, excepting that it is not a shut sac, closely resembles the serous tissue. The stroma is of new formation, and generally possesses great firmness and density; it creaks under the knife, and is of a dull, whitish, grayish, or pale yellowish color. The cystiform structure of colloid is easily recognized in all specimens of the disease, and is so remarkable that, once seen, it can never be forgotten. It is well illustrated in the annexed cuts; fig. 53 showing the external arrangement, and fig. 54 the internal.

The fibrous matter of colloid is almost destitute of free cellular substance. It receives, however, an abundant supply of vessels, as I have satisfied myself by dissection, and as is evinced also by the rapid development of the morbid growth, and the great bulk which it occasionally attains. In one case in particular I had no difficulty in tracing several large, straggling arteries into a tumor of this kind, showing that it had a very active circulation. The manner, however, in which the vascular system of the morbid product is arranged is not determined; nor is it ascertained whether it is of new formation, or derived solely from the surrounding and included healthy structures. Of the character of its nerves and absorbents, we are equally uninformed.

Fig. 53.

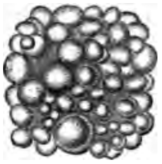
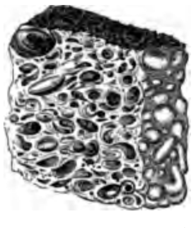


Fig. 54.



Colloid tumor. Fig. 53, external appearance. Fig. 54, internal structure. From a preparation in the author's collection.

The other element of colloid is an unorganizable product, of a whitish, greenish, or yellowish color, and of the consistence of ordinary jelly, whence the name by which the disease is usually known. In the older cells the matter is sometimes as firm as moist cheese, or the white of a hard-boiled egg, opaque, and of a white pearly or yellowish hue, interspersed with minute dark points. Sometimes, again, it resembles currant jelly, half dissolved glue, or a solution of gum shellac. However this may be, it never adheres to the walls of the cells, and is, therefore, easily enucleated, or pressed out. When perfect clearance has been effected of the cells of a mass of colloid, the fibrous structure exhibits very much the appearance of a piece of sponge, the alveolar arrangement being then particularly conspicuous, hundreds of cells being often visible upon a surface less than an inch in diameter.

Although the soft matter of colloid looks so much like jelly, chemical analysis has shown that it is entirely destitute of this substance, its principal constituents being albumen, casein, and osmazome, in varying proportions. Destructive analysis has yielded, in the 100 parts, 48.09 of carbon, 7.47 of hydrogen, 37.44 of oxygen, and 7.00 of nitrogen.

Under the microscope colloid appears as a homogeneous substance, with now and then a slightly granular arrangement, or large irregular plates. In this basis-structure are seen nucleated corpuscles, and large parent cells, inclosing several smaller ones. Cancer cells, such as occur in scirrhus and encephaloid, are occasionally found in it, but not as a necessary constituent, since in some specimens they are entirely absent. Moreover, it is worthy of notice that corpuscles, very similar to those of colloid, sometimes occur in gelatinoid infiltrations of the spleen, heart, and thymus. The stroma of colloid is essentially composed of fibrin.

It is impossible, in the existing state of our knowledge, to determine the precise nature of colloid, or to assign to it its proper position in the scale of the heterologous formations. It is certainly destitute of many of the properties of carcinomatous disease, and yet its career, so far as I have had occasion to watch it in my own practice, is not the less positively fatal especially when it occurs in the internal organs. In the osseous structures, it may occasionally be removed without relapse, and the same thing may probably be true in regard to colloid in some other situations; but upon this subject we are in need of further light. It has less disposition to ulcerate, and to contaminate the surrounding lymphatic ganglions, than the other heterologous formations.

5. MELANOSIS.

Melanosis, sometimes called black cancer, occurs most commonly in the cellulo-adipose tissue beneath the skin, in the folds of the mesentery and omentum, around the kidneys, in the mediastinal cavities, the lymphatic ganglions, the eye, liver, lungs, and parotid glands. It is also met with, though more rarely, in the serous and fibrous membranes, the bones, ovaries, heart, pancreas, and spleen. Occurring usually alone, it occasionally coexists with some of the other heterologous deposits, especially the scirrhous and encephaloid, and may attack quite a considerable number of organs either simultaneously or successively. It takes place in both sexes, and at all periods of life, but is most frequent in adults and middle-aged subjects.

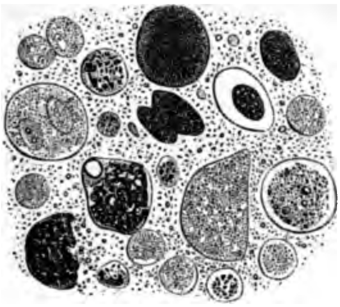
An instance in which the melanotic diathesis prevailed to a remarkable extent came under my observation in 1855, in a man, aged fifty-eight years, who, after a confinement of nearly twelve months, finally died in a state of extreme exhaustion, the prominent symptoms having been harassing cough, occasional discharges of blood from the bowels, irritability of the bladder, frequency of the pulse, and copious night-sweats. Melanotic tubercles existed in the subcutaneous cellular tissue in various regions, the lymphatic ganglions of the groin, axilla, and bronchia, the omentum and peritoneum, stomach, large and small bowels, pancreas, liver and gall-bladder, kidneys and supra-renal capsules, urinary bladder, prostate gland, seminal vesicles, lungs and pleura, heart, and thyroid body. The spleen and large vessels were sound. The brain, bones, and muscles were not examined. A remarkable feature in the case was the existence of numerous white and grayish tubercles in the midst of the black, showing that the former were in a nascent condition, having not yet undergone the melanotic transformation.

The melanotic matter is deposited in several *varieties* of form, of which the tuberoid is the most common. It occurs in small masses, of a rounded, ovoidal, or irregular shape, with or without a cyst, and from the size of a pin-head to that of a walnut. Of a dull sooty, brownish, or black color, they are generally invested by a distinct capsule, formed out of the cellular tissue in their immediate vicinity, which thus serves to separate and protect them. Fibrous bands generally intersect their interior, and vessels are often seen ramifying over their surface, none of them, however, dipping into the proper melanotic matter. It is by the union of several of these smaller masses that large tumors are sometimes formed, reaching, now and then, the volume of a fist or even of a fœtal head. Cases occur in which this matter presents itself in small points, or in irregular patches, generally beneath some serous membrane. Finally, it is sometimes found in a liquid form.

Melanotic matter, in a pure state, is of a sooty black, dark brown, or dull bistre color, its consistence varying from the fluidity of ink to that of fibro-cartilage. Its chemical constituents are albumen, fibrin, and a dark, highly carbonized substance, not unlike the cruor of the blood, with a minute quantity of iron, soda, magnesia, lime, and potassa. It is opaque, without odor or taste, and miscible with water and alcohol; it imparts a characteristic stain to linen, resists decomposition, and emits an empyreumatic smell when burned.

Examined microscopically, melanotic matter is found to consist of a fibrous network, inclosing numerous meshes, which are filled with free, unadherent pigment cells, of a pale yellowish, dark, or dark brown hue, and of a rounded, oval, or irregular figure; they are of great delicacy, and are occupied by colored granules, a few of the larger or older ones sometimes containing a nucleus with its nucleolus. These appearances are well represented in fig. 55. Pigment cells are not present in all cases, and their granules are occasionally seen in other structures, both healthy and morbid, as in the lung pigment and in the elements of carcinomatous growths.

Fig. 55.



Microscopic structure of melanosis.

The precise nature of melanosis is undetermined. I am, however, inclined to believe that it is merely a modification of encephaloid, the chief difference consisting in the superaddition of black pigment. What corroborates this view is that tumors partaking of the character of both these formations, occasionally co-exist, either in the same, or in different parts of the body; and also, that they exhibit similar histological elements.

Of the causes of this deposit nothing is known. It is always effused in a liquid form, and is wholly unorganizable, receiving neither vessels nor nerves; though these are freely distributed through its fibrous stroma. It has been supposed that black cancer might be communicated by inoculation, or immediate contact, but experiments upon the inferior animals have refuted this conjecture.

After having remained stationary for an indefinite period, this matter manifests a disposition to disintegration, the softening process generally beginning at some superficial point, and thence gradually extending to the skin, which, giving way, leads to the establishment of a foul, non-granulating, unhealthy ulcer, which no skill can cure. The discharge is generally of a sanious character, mixed with and discolored by the heteroclite secretion. Its progress is usually more tardy than that of scirrhus and encephaloid, except when it exists simultaneously in a great number of organs, as in the case above described, where it terminated fatally in a little over a year. The general health often suffers long before ulcerative action sets in, the patient becoming thin, haggard, and sallow.

Having thus described each malignant tumor separately, I shall, in the next place, offer some remarks on the origin of this class of affections, their diagnosis, and treatment.

Local Origin.—It has been supposed that all malignant diseases are occasionally of a purely local character, having their origin in causes entirely independent of the general system; or, what amounts to the same thing, that they may be developed under the influence of local injury. But such an opinion, it seems to me, is hardly tenable; at all events, it admits of great doubt whether such a result really ever follows such a cause; it certainly could not, one would suppose, unless there is a predisposition, a readiness, as it were, on the part of the system, to generate cancer cells, or to take on malignant action; else why is it that external violence, as a blow or bruise, so seldom gives rise to this horrible and unmanageable complaint? Why, in other words, is it that a blow will produce cancer in one person and not in another; or, still farther, why will one individual suffer and a thousand escape?

Cancer of the lip has often been attributed to the irritation produced by the hot and filthy stem of the earthen pipe in smoking. But it may well be asked whether the use of the pipe and the occurrence of this frightful disease should not be viewed rather in the light of a coincidence than in that of cause and effect? Be this as it may, it is unquestionable that thousands of persons smoke and yet never suffer from cancer of the lip. So in regard to many of the other circumstances alleged to be capable of inducing malignant disease, as grief, mental anxiety, loss of rest, unwholesome food, and disorder of the menstrual function, which are so often accused of provoking carcinoma in the mamma and uterus. Unless, therefore, a predisposition exists in the system to the development of these affections, it admits of great doubt whether it is possible for any local irritation to originate them. It is far more probable that they take their rise in the blood, but how, or in what particular element of this fluid, we are of course totally ignorant. It has been asserted that cancer cells have been detected in the blood, but if this has been the fact it is certain that they were not formed there, but that they were simply introduced through the agency of the vessels during the progress of carcinomatous disease. To arrive at any other conclusion would be absurd.

Can a tumor of an innocent, benign, or non-cancerous character, in its progress, become malignant? in other words, is such a growth capable of what has been termed the carcinomatous degeneration? It seems to me that it is not difficult to give a correct answer to this question. If the term "degeneration" is restricted to its true and legitimate signification we must reply in the negative, for no tumor, whatever be its structure, can, by a mere conversion or transformation, pass into a malignant condition. Such a change can be effected only under the influence of a vital process, involving the development and actual existence of the cancer cell; and I cannot, for my own part, see any good reason why a new growth, tumor, or deposit should be more exempt from such a disease than a primitive, original, or pre-existing tissue, whatever be its structure. Nay, indeed, may it not be supposed that the more feebly a part is organized, the more prone will it be to take on such a process? That this change does sometimes occur, may be inferred from the circumstance that tumors, believed to be cancerous, but which cannot be positively proved to be so, remain, occasionally, in a state of latency for ten, fifteen, twenty, and even thirty years, and then, all of a sudden, manifest a malignant and destructive action, generally followed by the worst consequences.

It would be of great practical utility if we knew the origin of cancer, or if we were acquainted with the causes, local and constitutional, under the influence of which malignant diseases, properly so called, are developed. But upon this subject, unfortunately, we are entirely ignorant, nor is it likely that our inquiries concerning it will lead to a satisfactory solution of a question which has occupied so much attention.

Carcinoma is sometimes *hereditary;* not, however, so frequently as is generally supposed. Besides, it should be remembered that there is a difference, and that a very wide one, between the transmissibility of this disease from the parent to the offspring, and its coexistence, or successive development, in different members of the same family. The latter occurrence, although also very infrequent, is much more common than the former, of which my own experience has supplied me with only a few examples. Lately, I saw a lady with a well-marked cancer of the mammary gland, whose mother and maternal aunt had died of the same disease. In the summer of 1850, I prescribed for an aged female with a cancer of the lip, whose mother had perished from cancer of the breast, and the father from cancer of the tongue. But the most remarkable and instructive instance of this kind, probably, upon record, is that related by Dr. Warren, in his work on Tumors. A man died of cancer of the lip; his son had a similar disease in the breast, from which, after having undergone an operation at the age of sixty, he finally lost his life. Two of his sisters had cancer of the mammary gland; they were operated upon, but ultimately died from a relapse of the malady. A daughter of one of the ladies had a cancer of the breast, which was removed at an early period; she recovered, but perished some years after from disease of the uterus. A daughter of the gentleman had a cancer of the breast, and there was reason to believe that other members of the family were affected by the same malady.

A case, almost equally remarkable, of this hereditary tendency to cancer, has been communicated to me by Dr. J. M. Warren. In this instance, a man who died of cancer of the penis, lost his father, grandfather, and great-grandfather from the same disease.

More frequently, as has been already stated, the disease occurs, either simultaneously or successively, in several members of the same family. My own practice has afforded me a number of instances of this kind, and there is not a writer on carcinoma that does not narrate examples of it. In one remarkable case, four out of six members of one family have died of the disease; one from cancer of the uterus; another from cancer of the mammary gland; a third from a malignant polyp of the nose; and the fourth from carcinoma of the thoracic viscera. Professor Gibson gives an instance of cancer of the breast in four sisters.

Diagnosis.—Epithelial cancer is usually sufficiently easy of recognition. Its situation at the junction of the skin and mucous membranes, or upon either of these structures; its origin in a crack, fissure, or wart-like excrescence; its extraordinary firmness, the part feeling like a mass of fibro-cartilage; its slow growth; its small size; and the absence, for a long time, of severe pain and constitutional taint; are features that cannot be mistaken.

The only characteristic sign of melanosis is the peculiarity of the color of the tumor; hence, when it is situated superficially, as when it occupies the skin, eye, parotid gland, or lymphatic ganglions, it is quite impossible to mistake the nature of the disease.

Colloid tumors are liable to be confounded with fibrous and enchondromatous formations; but a careful consideration of the history of the case, and a thorough examination of the morbid mass will generally serve to clear up any doubt that may arise in regard to the diagnosis. Colloid growths are usually situated in the peritoneal cavity, in the ovary, or in the bones; they are slow in their progress, smooth or rough on the surface, of uniform consistence throughout, and free from pain, their bulk being usually enormous, and the general health greatly disordered. Fibrous tumors advance slowly, seldom attain a great bulk, and do not usually seriously undermine the constitution. The enchondromatous growth is harder and less elastic than the colloid; its progress is rather rapid, and its outlines are always well defined, which is seldom the case with alveolar cancer.

Almost the only disease with which encephaloid is liable to be confounded is scirrhus, and it will therefore be necessary to point out their differential diagnosis. For this purpose I give the subjoined table of the characteristics of the two affections.

ENCEPHALOID.	SCIRRHUS.
1. The tumor is soft and elastic, not uniformly, but more so at some points than at others.	1. Uniformly hard and inelastic, feeling like a marble beneath the skin.
2. It grows rapidly and soon acquires a large bulk, perhaps ultimately attaining the volume of an adult's head.	2. Growth is slow, and bulk comparatively small; the tumor rarely, even in the worst cases, exceeding the volume of a double fist.
3. The pain is slight, and erratic, until ulceration begins, when it becomes more severe and fixed.	3. The pain begins early, is distinctly localized, and is of a sharp, darting, burning, or lancinating character.
4. There is always marked enlargement of the subcutaneous veins.	4. In scirrhus these vessels retain their natural size, or are only slightly enlarged.
5. The ulcer is foul and fungous, with thin, undermined, and livid edges, and is subject to frequent and copious hemorrhage.	5. The ulcer is incrusted with spoiled lymph, and has steep, abrupt edges, looking as if it had been punched in the part; bleeding little, and seldom.
6. There is generally early lymphatic involvement.	6. Usually not until late, or just before ulceration is about to occur.
7. Occurs at all periods of life.	7. Seldom before the age of forty-five.
8. Is most frequent in the eye, testicle, mamma, lymphatic ganglions, bones, and cellular tissue.	8. Never occurs in the eye and testicle, and seldom in the bones and lymphatic ganglions.
9. The disease usually terminates fatally in from nine to twelve months.	9. Seldom sooner than eighteen months or two years.

It is not improbable that an encephaloid tumor might be confounded with a chronic abscess, or an aneurism, especially when it is so situated as to receive an impulse from a neighboring artery. The very mention of the possibility of such an occurrence will be sufficient to put the young and inexperienced practitioner upon his guard, and serve to point out to him the absolute necessity of the most profound caution in every case of a suspicious character.

It has been proposed, in cases of doubt, to solve the difficulty by means of the exploring needle, or, rather, of an instrument so constructed as to admit of the removal of a portion of the morbid growth just sufficient to answer the purposes of a microscopic examination. I must confess, however, that I have a great aversion to all such procedures, believing that they generally prove prejudicial to the part, by provoking an increase of the morbid deposit, the puncture, unless very small, serving as a new centre of action. I have witnessed in at least two instances great harm from the operation, and have therefore of late years uniformly discountenanced it, except when the tumor is seated in an extremity, so as to admit, if found to be cancerous, of prompt removal by amputation.

The microscope is certainly not infallible as a means of diagnosis. It is often a valuable auxiliary, but nothing more. The practical surgeon must indeed be dull who cannot, as a general rule, determine the character of a morbid growth before he attempts its removal. The merest tyro in the profession has no difficulty in discriminating between a gelatinoid and a fibrous polyp of the nose, a scirrhous and an encephaloid tumor of the breast, or a common hypertrophied ganglion of the neck and a malignant growth of the same part. Every new growth, whether benign or malignant, has its peculiar features, not less than every pre-existing one. I believe that, with proper care, and a reasonable knowledge of morbid structure, such as every cultivated surgeon ought to possess, it is, in general, as easy to determine the difference between a malignant and a non-malignant tumor as it is to determine the difference between a muscle and a tendon. In making these remarks I have no desire to underrate microscopical researches; on the contrary, I only wish to state that they have not, in my judgment, effected all the good that has been claimed for them, especially in this particular department of pathology and practice, and that, therefore, their results should be received with some degree of allowance. In fact, the whole subject of morbid growths, benign and malignant, should be revised and re-examined. When there is so much dispute as there confessedly is at present respecting the real nature of the cancer-cell, or, whether indeed there is such a cell at all, it well becomes the practitioner to look with distrust upon many of the alleged discoveries of the microscope. Besides, he should not lose sight of the value of his unassisted senses, nor cease to cultivate them in the highest possible degree.

After a malignant disease, whatever may be its character, has made considerable progress, so as to impress itself upon the constitution, the diagnosis, however obscure it may have been in the early stages of the affection, is no longer doubtful. The worn and haggard features, the sallow complexion, and the emaciated and exsanguine condition of the system, are characters which it is impossible to mistake. The countenance bears the impress of the disease, looking as if it had been stamped with the seal of malignancy.

TREATMENT.

The treatment of the various forms of malignant growths may very properly be discussed under one general head, since they are evidently all governed by the same laws, both as it respects their origin, progress, tendency, and termination. All internal remedies, of whatever kind and character, have proved unavailing in arresting their march, or in modifying them in such a manner as to render the surrounding structures tolerant of their presence. The vaunted specific of the empiric, and the enchanted draught of the honest but misguided enthusiast, have alike failed in performing a solitary cure; and the science of the nineteenth century must confess, with shame and confusion, its utter inability to offer even any rational suggestions for the relief of this class of affections. But, although this is the case, yet it by no means follows that the subjects of these complaints may not be benefited by general and local treatment, if its application be directed by common sense and sound judgment. Every practitioner of experience knows how much ordinary local diseases are influenced by constitutional measures; and if this be true of these lesions, how much more must it be true of the malignant, in the production of which both the solids and fluids play such an important part. The attention of the surgeon should be particularly directed to the patient's diet, bowels, and secretions, and to the avoidance of all sources of local irritation, calculated to favor the morbid growth, and hasten the fatal issue.

The *diet* should, in general, be of a bland and unirritant character, but at the same time sufficiently nutritious to preserve a sound condition of the blood, and maintain the tone of the muscular system. All condiments, coffee, strong tea, pastry, hot bread, and the coarser kinds of vegetables and meats should be abstained from. Eggs, fish, oysters, and the white kinds of meat may be used once a day in moderate quantity, but oftener than this they should not be indulged in, unless there is some special reason for it, founded upon the state of the general health. Frequently a purely farinaceous and milk diet is found to answer better than any other, the patient not only thriving under it, but the disease being apparently kept in check by it.

The *bowels* should be maintained in a soluble condition, but all active purgation must be carefully avoided. The most suitable aperient, when a tendency to constipation exists, is a blue pill, with one grain of ipecacuanha, or equal parts of blue mass and jalap, at bedtime, followed, if necessary, by a Seidlitz powder in the morning. If evidence of gastro-intestinal irritation arise, the blue mass may be advantageously replaced by a small portion of calomel. In this way, while the bowels are maintained in a tolerably free state, the secretions are also duly preserved; a matter of no little moment in the treatment of all malignant diseases without exception, especially when they are attended with marked constitutional disturbance.

Sleep is procured and pain allayed by anodynes, the constipating effects of which are counteracted by the conjoined use of ipecacuanha or tartar emetic, in suitable doses. When the suffering is of a neuralgic character, the anodynes may be combined with arsenic or arsenic and strychnine.

If marked *debility* exists, recourse must be had to tonics, as quinine and iron, aided by a nutritious diet and the use of brandy, wine, ale, or porter. Night-sweats are best controlled by aromatic sulphuric acid.

Great care should be taken to keep the affected part perfectly at *rest*, and free from pressure and excitement. If it be the breast or testicle that is diseased, the organ must be well suspended, the dress worn loose, and all manipulation studiously abstained from. If the surface is tender, hot, and swollen, or œdematous, some mildly astringent and anodyne lotion will be of service, or the part may be painted several times a day with a weak solution of iodine. When the local inflammation is unusually severe, as is evinced by the discoloration and pain, nothing, according to my observation, will afford such prompt and decided relief as the application of from four to six leeches, unless it be a small blister, kept on until there is pretty free vesication. Some cases are greatly benefited by the use of an opium, belladonna, or cicuta plaster, renewed every ten or twelve days. All caustic applications are to be carefully avoided, inasmuch as they can never do any good, but may do a great deal of harm by establishing sores which it will afterwards be impossible to heal.

When the parts take on *ulcerative* action, the resulting sore must be kept constantly clean by frequent ablutions; while the excessive fetor which so generally attends must be allayed by the free use of the chlorides. The best dressing will be an emollient poultice, particularly that made of powdered elm bark, sprinkled, if there be much pain, with a little morphia, pulverized opium, or laudanum. If the ulcer be very sensitive, it should occasionally be touched, very lightly, with the solid nitrate of silver, or it should be kept constantly covered with the dilute ointment of the nitrate of mercury. When the discharge is very profuse, sanious, and offensive, a lotion composed of from two to four drops of nitric acid to the ounce of mucilage of gum arabic will be found exceedingly beneficial in diminishing its quantity and changing its character.

The affected glands in the neighborhood of the diseased organ often require attention, especially when they are very painful and bulky. The remedies should be of an anodyne and antiphlogistic character, especially leeches, iodine, and saturnine lotions.

The treatment of carcinomatous diseases *by compression* was introduced to the notice of the profession early in the present century by Sir Charles Bell, and, after having been alternately eulogized and condemned, has at length fallen into merited disrepute. Some years ago Mr. Arnott, of London, made an attempt to revive this mode of treatment, especially in cancer of the mammary gland, by the invention of a cup-shaped apparatus furnished with an elastic air-cushion, in order to apply the pressure in a more gentle and equable manner. The suggestion, emanating from so eminent an authority, attracted much attention at the time, and led to numerous trials, both in Europe and in this country, but with results so discouraging as to have caused its entire abandonment.

In regard to *extirpation*, all experience has proved that it cannot be relied upon as a means of permanent cure. The only benefit which it can confer is temporary relief for a few months, or, at most, for a year or two; and this is true no matter in how masterly and thorough a manner the operation may be executed. Hence not a few surgeons of the present day have expressed themselves as altogether averse to such a procedure, believing that it will only serve, in the great majority of instances, to hurry on the case to a fatal crisis. My own conviction is that interference with the knife is, as a general rule, only productive of harm, and that the patient will live quite as long without as with it, and, on the whole, in a state of greater comfort. Nevertheless, there are cases, although it is difficult to define their character, where we occasionally see an operation followed by highly beneficial results, not only ameliorating pain, but apparently preventing an extension of the disease, and relieving the mind of that terrible feeling of anxiety which is so sure to attend the more severe forms of carcinoma. The cases which have done best in my own hands, after operation, were females with scirrhous breasts, which, after having been long in a quiescent state, at length assumed a threatening ulcerative tendency, or which had actually, in a slight degree, yielded to this process.

Epithelial cancer is less liable to recur after extirpation than scirrhus, encephaloid, or melanosis. Removed in its earlier stages, there is occasionally a strong probability that there will be either no relapse at all, or only after a considerable period. One reason probably of this is the fact that the disease is more of a local character than the ordinary forms of carcinoma.

General Rules for conducting Excision of Malignant Diseases.—When excision is determined upon, it is a matter of paramount importance that it should be performed in the most thorough and complete manner, in order that the parts may be effectually guarded against relapse. The slightest atom of the new tissue, the most minute cancer cell, nay, possibly, the smallest particle of cancer juice, may, if left behind, endanger a reproduction of the malady.

1st. To accomplish this object, it is necessary that the incisions should be carried through the healthy tissues at some distance from the morbid deposit. Should any part have escaped the knife in the first instance, it should be traced out immediately after the extirpation of the main mass, and be excised with the most scrupulous exactness. Free use should be made, in this stage of the operation, of the sponge and finger; of the former, for clearing away the blood, and of the latter, for ascertaining the consistence of the surface of the wound. The sight alone should never be trusted in a case of this kind, inasmuch as it is a great deal more deceptive than the sense of touch. Not a particle of the least suspicious substance should be left behind. Skin, muscle, glands, vessels, nerves, and bone should all be sacrificed, if necessary to the success of the operation. Nay, the very atmosphere of the disease should be destroyed; and, with this view, the surgeon should always remove a considerable amount of healthy substance.

2dly. The operator should endeavor to preserve as much of the common integument as possible, in order to afford a complete covering to the surface of the wound. This rule is one of great importance, and should never be departed from. Another precept, of nearly equal consequence, but one which is not generally sufficiently insisted upon, is to preserve as large a quantity as practicable of the subcutaneous cellulo-adipose tissue, with a view of maintaining, unimpaired, the circulation of the skin. Whenever this is much interrupted, as it necessarily must be by a very close dissection, there is additional danger of a speedy return of the abnormal action, and also greater risk of erysipelas immediately after the operation.

3dly. When only a portion of an organ is involved by the heteromorphous matter, the rule is to remove, not a part, but the whole of it. Thus, in cancer of the mammary gland, the practice invariably is to extirpate the entire organ, no matter how small a portion may be implicated in the disease. Upon this point, surgeons have long been agreed. When the disease is seated in an extremity, especially the distal portion, the proper operation is amputation, not excision.

4thly. In removing a malignant tumor we should always endeavor to avoid loss of blood. This is a good rule, even when the patient is tolerably plethoric; but its observance is especially important in lean and fat subjects, the latter of whom, in particular, generally bear the loss of this fluid very badly. I deem it a matter of great moment to guard against hemorrhage in every operation of this kind, not so much on account of the immediate recovery of the patient, as on account of the danger of relapse, which, I confidently believe, is frequently very much increased by this accident.

5thly. It is a matter of great consequence, in reference to the question of relapse, that the whole of the wound left by the operation should be healed by the first intention. For this purpose, the parts should always be approximated as nicely as possible, not only at their edges, but also over the surface of the wound, that there may be no cavities or pouches for the lodgment of matter, but that the restorative process may proceed in the best and most rapid manner at every point. The most suitable dressings are a light compress and bandage, aided by adhesive strips or collodion plaster. Sutures are objectionable, because the tract made by them occasionally serves as a point of departure for new deposits, thereby promoting relapse. They cannot, however, always be dispensed with, especially when there is a scarcity of integument.

6thly. When the integument is defective, it is sometimes practicable to borrow the requisite amount from the surrounding parts; an operation first suggested, I believe, by Martinet, who imagined that we could thereby generally, if not always, effectually prevent a return of the disease. He thought we might thus change the functions of the parts in such a manner as to restore their healthy nutrition, and so counteract the tendency to the production of cancer.

I have had recourse to this procedure in a number of instances, in different regions of the body, especially in epithelial cancer of the lips and eyelids; but in none with any permanent or even protracted benefit. For a time the transplanted parts retained their healthy character; but at the end of a few months they gradually became hard and rigid, and soon thereafter exhibited all the evidences of carcinomatous disease.

7thly. When a sufficiency of integument cannot be obtained, and the wound is obliged to heal by the granulating process, it is worthy of consideration whether the whole of the raw surface should not be effectually cauterized with the nitrate of silver, or the acid nitrate of mercury, so as to form a superficial eschar. The practice certainly derives support from the beneficial effects which are said to follow the treatment of cancer by cauterization in the hands of the empirics, as well as in the hands of some scientific practitioners.

Finally, considerable diversity of opinion has existed among surgeons as lymphatic vessels and ganglions. Observation shows that nothing but mischief is to be expected from interference when the malady has attained this crisis.

5thly. A quickened state of the pulse, occasioned by the local irritation, augurs unfavorably. Excision, performed under such circumstances, is nearly always followed by speedy relapse; and it is, therefore, the duty of the surgeon to discountenance it.

6thly. Latent cancers should not be tampered with. Cases constantly occur in which, from neglect of this precaution, the patient loses his life, within a very short period after operation, from a return of the disease in its worst form. The reproductive powers of the part, if not of the system generally, usually manifest an astonishing activity under such circumstances, and the consequence is that the malady soon accomplishes its work of destruction.

7thly. It is not necessary here to insist upon the propriety of refraining from operation when there is serious disease of an important internal organ. Such a complication could hardly fail to predispose to relapse, if not to the speedy destruction of the patient.

Reproductive Tendency of Malignant Diseases after Operation.—Of the reproductive tendency of carcinomatous diseases, after extirpation, or destruction by the actual or potential cautery, writers have made mention from the earliest periods of medical science to the present time. Hippocrates was fully aware of the fact; and he entered his protest against all operative proceedings, under the conviction that, however early or well executed, they could not possibly afford any permanent relief, or guard the patient against a return of his malady. Similar views have been advanced by nearly all succeeding writers. If a different sentiment has occasionally been expressed, it has been by men who have had a very imperfect knowledge of the disease, who have been poor observers, or who have wilfully concealed the truth, from interested and dishonest motives.

The period at which relapse occurs varies from a few weeks to a number of years. On an average, it may be stated to be from four to six months. Occasionally it takes place within an almost incredibly short period. In one of my cases, the malady returned in less than three weeks. The original disease, which exhibited all the marks of genuine scirrhus, was of eight months' standing, and was seated in the left mammary gland, which it involved nearly in its whole extent; the nipple was somewhat retracted, and there was a slight enlargement of one of the lymphatic ganglions, which was removed in the operation. The dissection was performed with much care, and every particle of the morbid structure was apparently cut away; the greater portion of the wound united by the first intention, but a part of the centre remained open and became the starting-point of the new growth. The woman, who was forty-six years of age, died three months after the operation, having endured the most horrible torments.

Sometimes a relapse does not take place until the end of the first year; and in a few instances it is postponed to a later period, as the expiration of the second, third, and even fourth year.

But, although such cases are extremely interesting, yet they are altogether of an exceptional character; for, where one instance of this kind occurs, hundreds take place where the disease proves fatal within the first six months after the operation. In the exceptional cases, the affection is probably more localized than under ordinary circumstances; the malignant action, while it has a tendency to reappear at the cicatrice, or in the immediate vicinity of the original disease, having apparently no disposition to invade the general system.

All malignant diseases possess this tendency to relapse after ablation, but not in an equal degree. Encephaloid undoubtedly enjoys it to a far greater extent than scirrhus, and scirrhus than colloid. Melanosis also relapses with great frequency and promptness, and may be placed next to encephaloid in this respect. Again, it must be borne in mind that a genuine cancer is more certain to return than a cancroid affection, and, also, that it is more apt to prove rapidly fatal.

The reproductive tendency of malignant diease, after operation, is well illustrated by the following case:—A man, aged thirty-two, consulted me in April, 1851, on account of an epulis of the lower jaw, first noticed three months previously; it was firm, elastic, free from pain, of a pale-red color, and attached to the gum and jaw, extending from the ramus to the first bicuspid tooth. Two operations had already been performed upon it, each being followed by rapid relapse. On the 27th of April I removed the parts, along with the corresponding portion of the jaw. On the 24th of September I operated upon him a second time, removing the whole of the new growth, which was about the size of a pullet's egg, and about three-quarters of an inch of the anterior extremity of the ramus of the bone, from which the diseased structure seemed to spring. On the 31st of August, 1852, I excised the ramus at the articulation, the disease having attacked its inferior extremity. The man remained well until the winter of 1853, when the disease broke out in front of the ear, and soon formed a tumor of the size of a small fist, from the effects of which he rapidly sank. It is worthy of remark that the general health had been all along pretty good, and that the wound always healed well after each operation.

In a case of cancer of the lip, the particulars of which have been communicated to me by Dr. Barclay, of New York, also five operations were performed, the patient having survived the first excision a little more than seven years. In a case of encephaloid of the thigh, reported to me by Dr. C. S. Tripler, of the Army, the man did not die until five years after the first operation. I am acquainted with the history of a number of other examples nearly equally remarkable.

With the renovative tendency of melanosis every one is familiar. Hardly an example of permanent cure by operation is upon record. I recollect a remarkable instance of this recurring action which occurred, many years ago, in the practice of the late Professor McClellan, of this city. The disease seemed to have begun in several small subcutaneous tubercles of the abdomen, about the size and appearance of shot, which soon became exquisitely painful, and gradually bursting through the skin, were at length converted into foul, fungous sores, attended with a highly fetid, sanious discharge. Many of these tumors were extirpated, some in their crude, others in their open state; but, although the wound generally readily healed, they were always promptly succeeded by a new growth in the immediate vicinity of the original. The man became much emaciated, and finally died completely exhausted, with all the evidences of the melanotic diathesis.

The most interesting and extraordinary example of recurring encephaloid, of which I have any knowledge, is one which has been for nearly three years under my personal observation. The patient is an unmarried woman, aged forty-four, who in March, 1857, perceived in the left breast a small tumor, which was excised the following October. During the next sixteen months two more operations were performed, but as the mammary gland had been only partially removed, I extirpated the whole of it, along with a fourth tumor, in May, 1859, when the case was placed under my charge by Dr. Russell, of this city. The disease soon reappeared in the cicatrice, and in three months and a half again required the use of the knife. After four operations by myself the case fell into the hands of my former clinical assistant, Dr. Asch, who attended her until May, 1861, when I performed the twenty-second operation, the number of tumors removed, from first to last, being fifty-one, varying in size from a small almond to a pullet's egg. The encephaloid character of all was unmistakable. They generally recur at or near the cicatrice within a few weeks after extirpation, and speedily assume a fungating appearance. They are of a soft, vascular, brain-like structure, inclosed in a distinct capsule, and the seat of a thin, fetid discharge with little or no disposition to bleed. Occasionally she complains of sharp, shooting pains in the tumors, extending to the shoulder.

Her general health has all along been excellent; there is no lymphatic involvement in the axilla or elsewhere; menstruation has been going on well; and she has always rapidly recovered from the effects of the operations. The records of surgery may be challenged for a parallel case of this disease.

When malignant disease returns after extirpation, its tendency, as a general rule, is to assume the encephaloid type. This is true of all the different forms of these affections, whether they reappear at the site of the original disease, in the neighboring lymphatic ganglions, or in the internal organs. Hence the reason why the secondary disease is usually so rapidly fatal.

CHAPTER VIII.

SCROFULA.

The term scrofula had formerly a far more limited application than is accorded to it in modern times. It was originally employed to designate a glandular swelling of the neck, strikingly resembling the neck of the swine, whence its derivation. At present, however, it has a much wider signification, being made to include within its range quite a variety of diseases apparently of the most opposite character, yet in reality essentially alike in every particular. As meaning the same thing, the words struma and tubercular disease are frequently used.

The affections which may be comprised under this term are pulmonary phthisis, chronic enlargement of the ganglions of the neck and other parts of the body, hip-joint disease, psoas, lumbar, and chronic abscesses, Pott's disease of the spine, certain forms of follicular ulceration of the mucous membranes, arachnitis, otorrhœa, ozæna, ophthalmia, eczema, and ulceration of the bones. The fact is, the class of scrofulous maladies is almost endless, affecting as they do almost every part of the body, and assuming as they do almost every form of morbid action.

Scrofula consists essentially in the deposition of a peculiar morbid product long known by the name of tubercle. An attempt has lately been made to draw a distinction between the matter of tubercle and the state of the system which predisposes to its occurrence. It is difficult altogether to deny the propriety of this distinction; for there are unquestionably cases which we are in the habit of designating as strumous, where, nevertheless, there is not, so far as we are able to determine, the slightest strumous deposit. There would seem to be merely a strumous irritation in the part, without the part being in a condition to furnish any specific secretion, such as that to which we apply the term strumous, tubercular, or scrofulous.

There is another distinction, which, however, is fast losing ground, which it is more difficult to reconcile than that just mentioned. I allude to the alleged difference between phthisis and scrofula. It would be easy, if a work on surgery were the proper place to discuss the subject, to adduce argument upon argument to show the utter fallacy of this opinion. I have long taught the identity of these diseases, and endeavored to prove that the only real difference between them depends, not upon any difference in the morbid action, but solely upon the difference of structure, tubercular disease sharing the same fate, in this respect, as ordinary inflammation and as the other heterologous deposits. A tubercle in the lung is essentially the same disease as a tubercle in a bone or a lymphatic ganglion, having the same origin, running the same course, and producing the same results. Why then consider them as different?

Tubercular disease occurs at all periods of *life*. Sometimes, indeed, it exists as an intra-uterine affection, thus leading to the conviction that it is occasionally hereditary, or that it is transmitted in the very act of impregnation. When it occurs as phthisis, it is most common between the twentieth and fortieth year, and it is remarkable that after the age of puberty it exists rarely in any part of the body without involving the lungs. In children, the disease, considered in a general point of view, is most liable to happen between the third and tenth year. A vast majority of the cases of scrofulous disease that are met with in practice, in the form of coxalgia, Pott's disease, caries of the short bones of the extremities, arachnitis, ophthalmia, otorrhœa, tonsillitis, and chronic enlargement of the lymphatic ganglions, occur at this period of life, and constitute an immense source of mortality. It is a remarkable fact that adults seldom suffer from external scrofula; and, on the other hand, it is equally remarkable that children suffer comparatively little from consumption, so common among persons after the age of twenty. In old age the disease rarely occurs in any form.

Struma is frequently *hereditary*. The children of consumptive parents are often cut off by the same disease, or they suffer in various parts of the body, as the bones and joints, the lymphatic ganglions, the eye, ear, and serous membranes. Whole families are sometimes destroyed by it. Occasionally the disease skips one generation, and reappears in another, owing, doubtless, to some temporary improvement in the intermediate offspring.

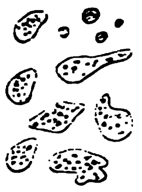
The tubercular deposit has been observed in nearly every *structure* of the body. The only parts, perhaps, in which it does not occur, are the skin, vessels, nerves, ligaments, aponeuroses, tendons, and voluntary muscles. Of the organs, properly so called, there is not one which is not, at times, its seat. Experience, however, has shown that it manifests a decided preference for certain organs and parts of organs. Thus, it occurs most frequently in the lungs, particularly their summits, then in the lymphatic ganglions, next in the spleen, serous membranes, and mucous follicles of the alimentary canal, then the bones and joints, and finally the liver, kidneys, testes, and false membranes of the serous cavities. Its coexistence in various parts of the body, or its almost universal diffusion, is sufficiently frequent, and constitutes the so-called strumous diathesis.

The deposit being a direct product of the blood, occurs both in the interstices and upon the free surfaces of the organs. Hence it exhibits itself in various *forms*, of which the tubercular is by far the most common, the stratiform and infiltrated being, indeed, exceedingly rare. The tubercular variety occurs in little masses, from the size of a millet-seed to that of a pea, of a pale yellowish or grayish color, and of a consistence ranging from that of curds or soft putty to fibro-cartilage, hundreds and even thousands often existing in a very small compass. When very numerous and closely grouped together, they sometimes coalesce, so as to form a considerable sized tumor. The stratiform variety of the deposit is most common upon mucous surfaces, while the infiltrated is met with chiefly in the lungs, around tubercular excavations, and in the lymphatic ganglions. Whatever shape it may assume, it is always deposited in a fluid state, from which, however, it passes speedily into the solid form, which it retains for a certain period—generally from six to twelve months—when, becoming softened and disintegrated, the part makes an effort to rid itself of it. These changes are followed by the formation of a cavity, named a strumous abscess, of which the best examples occur in the lungs, bones, and lymphatic ganglions. The matter is peculiar; being generally of a yellow-greenish color, of a cream-like consistence, and intermixed with small whitish flakes, very similar to broken-down grains of boiled rice.

Microscopically examined, it is observed to consist of a transparent matrix, inclosing granules, nuclei, cells, and oil-globules, the relative proportions of which vary in different specimens, and even in different portions of the same mass, the chief circumstances which influence its minute structure being the age of the deposit, the nature of the affected organ, and the general condition of the subject. Most of the granules are very minute, and afford an albuminous reaction; they exist in great numbers in yellow tubercle, and often contain so much fatty matter as to be completely dissolved by ether.

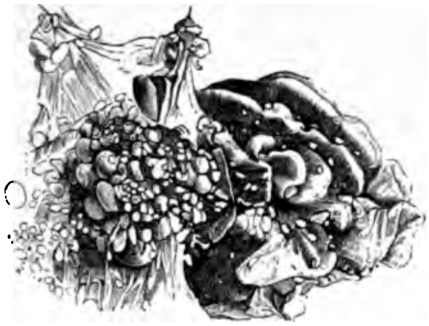
The free nuclei, or true tubercle corpuscles, are round, ovoidal, oblong, or almost shapeless, and vary in size from $\frac{1}{2500}$ to $\frac{1}{3500}$ of an inch in diameter. They constitute a large proportion of the morbid product, and are generally intermixed with epithelial cells, oil globules, and crystals of cholesterine. The adjoining cut, fig. 56, from a drawing by Dr. Da Costa, conveys a good idea of the microscopical characters of tubercle as it occurs in different parts of the body. In fig. 57, it is seen as it is deposited in the lymphatic glands.

Fig. 56.



Tubercle corpuscles.

Fig. 57.



Tubercles in enlarged mesenteric glands from a scrofulous patient.

Tubercular matter, in its crude state, consists almost entirely of albumen, with a small quantity of earthy salts, particularly phosphate and carbonate of lime. Some specimens also contain a little fibrin, casein, extractive matter, and pyine; but the great and pervading substance is albumen, or protein matter.

The microscopical and chemical examinations of this matter are extremely valuable, inasmuch as they go to show the low grade of its vitality, and its consequent inability to maintain, for any length of time, its parasitic existence. Certain authors, founding their opinion upon these facts, look upon it as an unorganizable product, very much of the same nature as that of colloid and melanosis. In this view, however, I cannot concur; for I have investigated tubercular matter too often, and under too many varying circumstances, not to be convinced that it is susceptible of organization, although certainly in a less degree than scirrhus and encephaloid. It is, in point of vitality, a more humble substance than either of these; it occupies a lower grade in the scale of cell development; and has a greater quantity of protein matter. Nevertheless, we must concede to it a certain degree of life-power, a certain form of organization, otherwise it would be impossible to explain the various changes which it undergoes, and the fact that it occasionally contains distinct vessels, clearly traceable into its interior, and intended to minister to its nourishment and protection. The matter of colloid is very different from that of tubercle, in having no attachment to the cells in which it is contained, in being alike in all stages of its existence, and in never experiencing any transformations. The same is true of melanosis. If this substance is occasionally very hard, it is because of its involvement with its fibrous matrix, or the surrounding tissues. Tubercle, on the contrary, is always firmly adherent to the parts with which it is in contact, except when it is effused upon mucous surfaces, acquires a firm consistence during its development, and often undergoes absorption, or the earthy transformation. Besides, the softening process frequently begins in the very centre of the morbid product, which could certainly not happen if it were an inorganic substance. Those who deny the vascularity of tubercle attempt to account for the occasional existence of vessels by supposing that they become imprisoned in its substance during the progress of its formation. That this view is sometimes true is highly probable, but it is applicable only to certain parts of the body, and then only under certain circumstances. The explanation is undoubtedly not admissible in those cases where the tubercular matter is deposited upon the free surface of the serous membranes or in the substance of the adventitious, where its vascularity is so often observable. This matter, however, is not always organizable. Like coagulating lymph, it is sometimes deprived of its vitality almost in the very act of its secretion. This is particularly the case when it is effused upon the free surfaces of the mucous membranes, especially those of the urinary passages, whose irritating contents speedily render it effete.

Of the exciting *causes* of tubercular disease our knowledge is rather conjectural than positive. It may be fairly inferred, however, from the numerous observations that have been made upon the subject, that, when the tendency to the disease exists, anything calculated to produce excessive debility, or an impoverished condition of the blood and solids, may provoke the morbid deposit. The causes which are most likely to bring about this effect may be thus stated: 1. Meagre and unwholesome diet, deficient in fibrinous, albuminous, gelatinous, and fatty qualities. 2. Protracted disorder of the digestive organs, particularly the various forms of dyspepsia. 3. Exposure to cold, and confinement in damp, ill-ventilated, ill-lighted apartments. 4. Exhausting fevers. 5. Excessive and long-continued evacuations of blood. 6. Severe courses of mercury. 7. Stoppage of habitual discharges, as the menstrual and hemorrhoidal. 8. Protracted mental depression. 9. Tertiary syphilis. All these causes act by lowering the vital principle, and diminishing the plastic properties of the blood.

The immediate cause of the disease is inflammation, which regulates, not only the quantity, but also the quality of the deposit. The inflammation is generally of a low grade, and is therefore not characterized by the ordinary phenomena, although it is not the less effective on that account. The reasons which may be adduced in support of this view are the following:—

1. Irritation of the lung, mechanically excited, will frequently give rise to tubercle in that organ, as is occasionally seen in cases of foreign bodies, accidentally introduced through the larynx. In the inferior animals, as the dog and rabbit, mercury dropped into the trachea will often induce the disease in a short time. Miners, needle-grinders, and weavers, who are habitually exposed to the inhalation of gritty and irritating matter, are particularly prone to phthisis.

2. This view of the origin of the disease is countenanced by the composition of the deposit; for we know of no substance which contains so much albumen, or albumen and fibrin, that is not the product of inflammation.

3. Tubercle bears a great resemblance to coagulating lymph, especially the more degraded forms of that substance, and this, as every pathologist is aware, is always the result of inflammatory action.

4. The disease is often developed under the immediate effects of cold, and various other causes which have a tendency to produce congestion of the internal viscera. Indeed, it is well known that dyspeptics and persons who live upon unwholesome food, or in damp and ill-ventilated apartments, are peculiarly liable to suffer from this disease.

The *duration* of strumous disease is too variable to admit of any accurate general statement. Phthisis usually destroys life in from nine to eighteen months; tubercular arachnitis often terminates fatally in a few days; while external scrofula may last for years, and finally eventuate in recovery.

The *symptoms* vary, of course, according to the nature of the affected structure, but, whatever this may be, there are certain appearances which are hardly ever absent in any case. Thus, whether the disease be seated in the lungs, in a bone, a joint, or simply in the cellular tissue, in the form of a cold abscess, there is always, during the progress of the malady, excessive emaciation; for, with the exception of the glandular viscera, the brain, nerves, and a few other structures, there is hardly an organ in the body that does not, in some degree, participate in the general atrophy. The fat gradually but surely disappears; the muscles are pale, flabby, and attenuated; the cellular tissue is deprived of its moisture; the skin is soft and blanched; the hairs grow slowly, and many drop out; the nails are thin, and frequently incurvated; and the bones, although they retain their size, are unusually light, and saturated with sero-oleaginous fluid. The blood also is altered. It is impoverished, thin, pale, and deficient in globules. The clot is unnaturally small and dense, and, when the disease is fully established, with a tendency to suppuration, is almost always covered with a buffy coat. The fibrin is not materially changed until softening sets in, when it increases disproportionably in quantity, and so continues until suppuration begins, when it attains its maximum. These changes are generally very conspicuous in phthisis, psoas abscess, and extensive disease of the lymphatic ganglions.

Scrofula has been supposed to be *contagious*, and many experiments have been performed, both upon man and the inferior animals, with a view of deciding the question. In no instance, however, has the operation succeeded. Kortum applied scrofulous pus to sores and wounds in the necks of children, but always failed to induce the disease. Hébreard and Lepéllitier performed similar experiments upon dogs and guinea-pigs with a like result. Finally, Goodlad and others attempted, with no better success, to create the disease in their own persons by inoculation. The idea of the contagious character of phthisis was formerly very prevalent, but is now obsolete.

Persons who are affected with scrofula, or who are laboring under what is termed the *strumous diathesis*, exhibit certain peculiarities which may be considered as almost characteristic. These refer mainly to the state of the complexion, the digestive apparatus, and of the circulation.

The complexion is generally brunette, and the hair, for the most part, dark, although in both these respects the greatest possible diversity exists. The eyelashes are drooping and of extraordinary length; the pupils are habitually dilated; the upper lip is tumid; the face is pale and puffy; the hands and feet are nearly always cold; the body is unusually impressible by atmospheric vicissitudes; the abdomen is hard and distended; there is a deficiency of muscular strength; and the intellect is dull and sluggish, instead of being sprightly and precocious, as is usually represented. The digestive organs are subject to frequent derangement; the appetite is irregular and capricious; the bowels are either constipated or relaxed, seldom entirely natural; digestion is feeble and imperfect; great annoyance is experienced from flatulence and acidity; and the individual is often a martyr to dyspepsia. Children predisposed to struma are particularly prone to cutaneous eruptions about the scalp, to purulent discharges from the ears, and to chronic enlargement of the tonsils.

There is another class of strumous subjects of a state of mind and body almost the opposite of that just described. The complexion is light and florid, the eye blue, the mind unusually active, and the cutaneous circulation quite vigorous. The parts of the body which are most liable to suffer, in this form of constitution, are the bones and joints, the eye, skin, and lymphatic ganglions, particularly those of the neck, consumption being much more rare than in the dark variety.

Scrofulous Ulcer.—Various scrofulous affections of the skin give rise to ulceration, but, perhaps, the most characteristic ulcer of this kind is that consequent upon suppuration of the lymphatic ganglions of the neck, groin, and axilla. Be this as it may, the features of the scrofulous ulcer are so peculiar as to require distinct notice.

The surface of the scrofulous ulcer is always unhealthy, being coated with rough, aplastic matter, of a pale yellowish or grayish color, hard, and firmly adherent to the subjacent structures. There is reason to believe that this matter, which possesses none of the characteristics of laudable pus, is often intermixed with disintegrated tubercular substance. In many cases the bottom of the ulcer is formed by altered lymphatic ganglions, of a reddish appearance, and so much softened as to break down under the slightest pressure; sometimes, however, they are hard, almost of a fibrous consistence, and as if they had been partially dissected from the surrounding parts. In some cases, in fact, they separate, or slough out, several perhaps coming away at the same time, or in more or less rapid succession. No healthy granulations exist upon such a sore, unless it is in a healing condition, and even then they form and maintain themselves with great difficulty.

The edges of the ulcer are characteristic. They are of a bluish, purplish, or reddish hue, undermined, hard, jagged, thin and sharp at some points, thick and obtuse at others. Occasionally they look as if they were bent in towards the bottom of the ulcer. They are generally remarkably insensible, incapable of forming granulations, and deeply congested, the blood passing through the vessels in a very languid and imperfect manner. In fact, the skin, having lost its support, is excessively impoverished, and has great difficulty in maintaining its vitality.

The parts around the scrofulous ulcer are generally hard, either from the presence of indurated and diseased ganglions, or from interstitial deposits; usually, in fact, from both. The skin is red and congested, and not unfrequently also somewhat œdematous, pitting on pressure. The swelling is often great and disfiguring; in short, characteristic of that peculiar appearance from which the disease originally derived its name, the neck, when that is the affected region, strikingly resembling that of the swine.

The scrofulous ulcer may be single, or there may be more than one; variable in shape and extent, and frequently communicating with considerable sinuses. The discharge is ichorous, or thin and whey-like; sometimes thick and yellowish; in either case, apt to be intermixed with the débris of disintegrated ganglions, flakes of lymph, and broken-down tubercular matter.

Treatment.—The treatment of scrofula, like that of cancer, has been exceedingly diversified and empirical, for there is hardly a solitary article of the materia medica that has not, at one time or another, been called into requisition. Even at the present day, when the pathology of the disease is so much better understood, the greatest uncertainty prevails in regard to our therapeutic measures, and the consequence is that few practitioners approach the disease without doubt and misgiving as to the benefit they may be able to confer by their treatment. Strumous affections have always afforded a vast field for the charlatan, and his pretensions have never been more impudently paraded before the public than in our own day. One, if not the chief, reason of this is that so few practitioners really understand the nature of this class of diseases; they seem to forget, or not to know, that they occur in every possible form and under every variety of circumstances, and that, in order to meet them successfully, it is necessary constantly to vary our remedies according to the exigencies of every particular case. I am certain, from no little experience upon the subject, that the results of our treatment hinge most materially upon a just discrimination of the different states of the system under which these affections occur. To treat every case of scrofula alike, without regard to the state of the system which attends it, is the climax of absurdity. Let the practitioner remember that scrofula has no specifics, and he will soon cease to employ his remedies empirically. The indiscriminate use of iodine and cod-liver oil in this affection has done mankind and the profession an immense deal of harm.

It will be sufficient, for practical purposes, to consider scrofulous subjects as being divisible into two great classes, the enfeebled, and the vigorous; that is, those who have but little constitutional stamina, and those who, although affected with a strumous taint, are comparatively stout and robust, possessing a ruddy complexion, and an active cutaneous circulation. The latter, undoubtedly, constitute the minority of the cases that come under our observation, but they are, nevertheless, sufficiently common, and so well marked as to be easily recognized by the most superficial observer. Now, to treat these two classes of subjects on the same principle, as is so generally done, is contrary to the dictates both of sound sense and daily experience. While cod-liver oil, iodine, and tonics will perform wonders in the naturally weak, they will be of little avail in dislodging and curing the disease in the naturally robust; and, conversely, while the lancet and tartar emetic will be of immense service in the latter, their employment can scarcely fail to be eminently prejudicial in the former. Let it not be imagined, however, that one mode of treatment is applicable to all cases of this form or that form of the disease; on the contrary, circumstances constantly arise during the progress of each particular case which imperatively call for a change of remedies, and it is in the knowledge of this circumstance that the great art of curing the malady lies.

It is well, as a general rule, to begin the treatment with some mild but efficient aperient, to clear out the bowels, and improve the secretions. Our course must then be shaped by the peculiarities of the case. If the patient be naturally very feeble, or has become so in consequence of protracted suffering, an alterative and tonic course must at once be instituted, as the most likely to meet the indications; but if, on the other hand, he is strong and plethoric, as denoted by the state of his pulse and complexion, much time will be gained, and structure saved, by the use of antiphlogistics, especially tartar emetic and Epsom salts, in the form of the saline and antimonial mixture, properly guarded with tincture of opium. The lancet must be employed with the greatest care; but I am satisfied that it is often of immense benefit in arresting the morbid action, and that it has fallen into too much neglect in the treatment of scrofulous diseases. In scrofulous inflammation of the eye, throat, and lymphatic ganglions, its effects are often marked and permanent. But there is a time when the employment of antiphlogistics ceases to be proper, and when they may be superseded by other remedies, similar to those generally applicable in the more common form of the disease. If the depletory system of treatment is carried too far, it cannot fail to do harm by exhausting the vital powers, and thus creating a disposition, in different parts of the body, to the deposition of tubercular deposits.

Among the various remedies that have been employed from time to time for the cure of scrofula, *iodine* holds a prominent rank. This article was first introduced to the notice of the profession, as a therapeutic agent, in 1820, by Dr. Coindet, of Geneva, and since that time its efficacy in the treatment of this affection has received the most ample confirmation. Indeed, it may be regarded as the remedy *par excellence* in this disease. It may be employed alone, or in union with other substances, as potassa, iron, mercury, lead, quinine, barium, and ammonia, and hence much judgment is often required to determine what particular form of the remedy is best adapted to a particular case or form of the malady. As a general rule, it may be observed that, when a purely alterative effect is desired, it may be exhibited by itself, in substance, in tincture, or in the form of Lugol's concentrated solution, consisting of one scruple of iodine and double that quantity of iodide of potassium, dissolved in seven drachms of water. Of this the patient may take from five to ten drops every eight hours, in a wineglassful of sweetened water, the dose being gradually increased to fifteen, twenty, twenty-five, and even thirty drops, according to the tolerance of the system.

With the same view the *iodide of potassium* is not unfrequently administered alone; and, when scrofula is associated with constitutional syphilis, rheumatism, or mercurial disease, it certainly constitutes one of the best forms in which iodine can be exhibited. With whatever view it may be employed, it is proper always to begin with small doses, as four or five grains, if the patient be an adult, and gradually to increase them to ten, twenty, and even thirty grains, three or four times a day. The most eligible way of giving it is in water, or in union with the fluid extract of sarsaparilla. Some patients take it very well in hop tea, and when there is much restlessness at night, or nervous irritation, this is perhaps the best form in which it can be exhibited.

When the liver is at fault, or when there is a syphilitic taint of the system, or much disorder of the secretions, the *protiodide of mercury* may be advantageously prescribed, in doses varying from the fourth of a grain to half a grain, three or four times a day. The *biniodide* may be employed with the same view, but it should be recollected that it is much more potent, and that, therefore, greater caution should be observed in its administration. The dose, which at first should never exceed the one-twelfth or one-sixteenth of a grain, may be gradually augmented to a fourth or even half a grain, given in the form of pill, or dissolved in alcohol.

When an alterant and tonic effect is indicated, nothing can be better than the *iodide of iron*, or the iodide of quinine. The former of these articles is one of the most valuable anti-scrofulous remedies that we possess, and one which rarely entirely disappoints expectation. In my own practice I have found it particularly beneficial in strumous disease of the cervical ganglions, of the upper lip, the eye, and joints. I often give it in solution, but more commonly in the form of pill, in combination with quinine and opium. If vascular action be present, a minute portion of tartrate of antimony and potassa may be added to each dose. In children, who cannot take pills well, the best mode of administering it is in combination with syrup of orange-peel, or syrup of sarsaparilla.

The *iodide of quinine* has been advantageously employed in the treatment of scrofulous tumors, in cases where iodine and tonics are indicated, in doses from one to two grains every six or eight hours.

In whatever form iodine be employed, whether as a simple or compound, it must be borne in mind that the system should be free from all vascular excitement, and that, after it has been exhibited for a fortnight, it should be pretermitted for several days, when it may be resumed, and given as before. Employed in this manner it exerts a much happier influence upon the progress of the complaint, and is much less likely to disagree with the stomach and bowels, than when given uninterruptedly. In case it acts as an irritant, it must be exhibited in smaller doses, or be combined with opium or hyoscyamus. Great mischief often results from neglect of this precaution.

Another remedy of great value in the treatment of scrofulous disease is *barium*. It has repeatedly succeeded in my hands when other means have proved inefficient or entirely unavailing; it is particularly valuable in chronic enlargement of the cervical ganglions, both before and after the establishment of suppuration. It is chiefly adapted to patients with a languid circulation, a pale tallow-like complexion, a flabby tongue, indigestion, and cold extremities. Its use is contra-indicated when there is inflammatory excitement, or congestion of any important organ. The best mode of administration is the such quantity as to oppress the stomach. In the latter stages of the malady, or even earlier, if the strength seems to require it, some of the lighter meats, a little fresh fish, or a few oysters may be taken twice a day, along with a glass of porter, ale, sherry, port, or Madeira, or, what is better than all, of brandy and water. Sometimes an almost purely animal diet seems to agree best with the stomach. Many patients are greatly benefited by the free use of whiskey, rapidly becoming strong and fat under its influence. It should be taken repeatedly in the twenty-four hours, in quantities suited to the state of the stomach and system.

As an important auxiliary *exercise* claims particular attention. It may be taken on foot, in a carriage, or on horseback, as may be most convenient or agreeable to the sufferer, and should be indulged in whenever the weather admits of it. Care is taken that it is never carried to fatigue. In bad weather, the patient may use dumb-bells, or amuse himself in sawing wood, planing, or anything else to which he may have access. Children should be carried about in their nurses' arms, or in handcarts.

Particular attention must be paid to the patient's *clothing*. He must be warmly clad. Flannel should be worn next the surface, both in summer and winter, the feet should be protected with thick shoes and stockings, and the skin should be maintained in a healthy, perspirable condition by frequent ablutions with tepid water, impregnated with common salt, ground mustard, strong soap, or any other exciting substance.

A change of *air* is sometimes of vast service, and has been known to be of itself almost sufficient to effect a cure in this disease. The locality selected should be as healthy as possible, and not liable to great or sudden variations of temperature. If the atmosphere be dry, it matters little whether it be cold or warm, provided it does not run into either extreme. A residence near the sea-shore is often of immense benefit.

In the latter stages of the disease, when the patient is harassed with hectic fever and diarrhœa, the treatment must be of a tonic and stimulant character. The diet must be highly nutritious; porter, ale, wine, and milk-punch must be freely used; the bowels must be restrained with astringents; the excessive sweats must be controlled with quinine and elixir of vitriol; and sleep must be procured and pain allayed with anodynes.

There is no doubt that the state of the *mind* is capable of exercising a powerful influence upon the cure of scrofula, especially when seated in the external parts of the body. We may assume this to be a fact from the astonishing benefit which so often followed the royal touch, a practice which is said to have originated in the time of Edward the Confessor, near the middle of the eleventh century, and which continued down to the reign of Queen Anne. The belief in the efficacy of the royal touch seems to have been a long time almost universal in Britain. It was particularly prevalent in the reign of Charles II., who, in one single year, touched nearly 100,000 persons, who flocked to him from all parts of England, Ireland, Scotland, Jersey, and Guernsey. The practice was generally accompanied by prayers and other religious ceremonies, and particular days and seasons were set apart for its observance. The effect of this singular remedy was variable; in some of the patients a cure followed almost immediately after they were touched; in others, the relief was more tardy, but in the end not the less effectual; occasionally the process was obliged to be repeated; and in some cases the treatment was entirely useless. Richard Wiseman, who was surgeon to Charles II., and a most sagacious observer, must have had great confidence in the efficacy of the royal touch; for he expressly declares that "His Majesty cured more persons of scrofula in one year than all the chirurgeons of London in an age."

The *local treatment* of scrofula merits some attention, although it can be alluded to here only in a very general manner, as each affection comprised under this denomination requires a mode of management in some respects peculiar to itself. The most important topical remedies are leeches, blisters, issues, pustulation with croton oil, tincture of iodine, embrocations, and sorbefacient unguents, especially such as have iodine for their bases, as the iodides of mercury, lead, potassium, iron, barium, and zinc. Leeches are often of immense service; and, as to counter-irritants, they can rarely be dispensed with in any case. Of the various sorbefacient applications none holds a higher rank, in my opinion, than the tincture of iodine, either pure, or, as I generally prefer, considerably diluted with alcohol. It is used as in ordinary inflammation, and often exerts a powerful influence upon the progress of external scrofula, especially of the joints and cervical ganglions. Blisters, too, are a valuable means of relieving local congestion, modifying capillary action, and removing morbid deposit. If the part affected be a joint, rest, long and faithfully continued, will be necessary, if, indeed, not indispensable. If abscesses form, they must be opened, with the precaution, if possible, of excluding the atmosphere, experience having shown that such ingress is highly prejudicial, not on account of anything noxious in itself, but because of its tendency to cause decomposition of the contents of the sac, and, consequently, violent reaction, or hectic irritation. The swelling is attacked in its most depending part, the knife being introduced in a valve-like manner, and the opening immediately closed with adhesive strips, supported by a compress and roller. The practice of permitting such accumulations to continue until they have seriously impaired structure, or caused intense suffering, cannot be too pointedly condemned.

When the enlarged glands obstinately resist treatment, they should be excised, provided that they are sufficiently accessible to the knife, and also that there is no serious internal disease forbidding interference. An operation is particularly indicated when the morbid growths press upon important neighboring structures, or when they are a source of deformity, as when they are situated in the neck or about the angle of the jaw. The dissection is often tedious and bloody, especially when a large chain of glands has to be removed, and is then very liable to be followed by erysipelas and other bad consequences.

The scrofulous *ulcer* must be treated rudely at first, and gently afterwards. The undermined edges are cut away with the knife or scissors, and the surface is thoroughly touched with dilute acid nitrate of mercury, the solid nitrate of silver, or sulphate of copper, the application being repeated every other day until there is an appearance of healthy granulations, when milder means, such as opiate cerate, or the dilute ointment of nitrate of mercury, take its place. If disintegrated ganglions are present they should be removed with the knife, or destroyed with the Vienna paste; for so long as they remain no substantial progress can be made towards a cure. Sinuses are traced out with the bistoury, unless they involve important structures, when stimulating injections, or the seton, must be used instead. Valuable aid will often accrue in these cases from the daily application of the dilute tincture of iodine to the surface immediately around the ulcer.

CHAPTER IX.

WOUNDS.

SECT. I.—GENERAL CONSIDERATIONS.

The term wound is a generic one, being employed to designate all injuries attended with a division of tissue, inflicted by sharp, pointed, or blunt instruments and weapons of every description. The breach, or solution of continuity, may be apparent or concealed; that is, upon and in the skin, as well as in the more deep-seated structures, or the skin may retain its integrity, and the wound be strictly subcutaneous.

Wounds are constantly made by surgeons in the legitimate exercise of their professional duties, as in the removal of limbs, tumors, and urinary calculi, and in the restoration of lost or mutilated parts. In general, however, they are inflicted accidentally, and hence, as this may happen in a great variety of ways, they are very properly arranged under different heads, according to the manner in which they are produced. Thus, a wound is said to be incised when it is caused by a sharp instrument; lacerated or contused, when it is made by a blunt body; and punctured, when the weapon is narrow and somewhat pointed. A gunshot wound is a breach inflicted by a ball. In a poisoned wound the tissues are inoculated with some peculiar virus, either secreted by an appropriate apparatus in the bodies of certain animals, as the bee or snake; contained in the salivary fluid, as in the dog in hydrophobia; or developed after death, as in the human subject in the dead-house. The term penetrating is employed when the wound communicates with a cavity, as a joint, the chest, or the abdomen.

Wounds are also generally named according to the region of the body which they occupy, or the particular tissues, organ, or cavity which they affect and interest. Thus we are accustomed, in common parlance, to speak of wounds of the head, neck, chest, abdomen, and extremities; of wounds of the skin, muscles, tendons, vessels, and nerves; of wounds of the stomach, heart, lungs, liver, and brain; and of wounds of the joints, pleura, pericardium, and peritoneum.

Finally, wounds may be superficial or deep; recent or old; simple or complicated; oblique, transverse, or longitudinal. The meaning of these terms is too obvious to require any particular explanation. The most common complications which attend their occurrence, or which arise during their progress, are, hemorrhage, the presence of foreign matter, abscesses, mortification, erysipelas, pyemia, and tetanus. These accidents, whether in their individual or combined capacity, often completely change the character of a wound, rendering complex what was originally perhaps perfectly simple, and dangerous what was, in the first instance, perhaps so insignificant as hardly to attract serious attention.

The characteristic features of wounds will be pointed out in connection with the different classes of injuries to which they relate. The prognosis and treatment will also receive due attention. I shall therefore content myself here by stating, in general terms, that the great and leading indications, in every wound, whatever may be its nature, are, first, the stoppage of hemorrhage; secondly, the removal of extraneous matter; thirdly, accurate approximation and retention of the edges of the solution of continuity; and, lastly, the prevention of inflammation, tetanus, and other untoward occurrences. In every case, the most prompt attention should be given; the parts should be handled in the most cautious and gentle manner; and the dressings, which are never to be too officiously interfered with, should always be as light as possible. In short, whatever is done, should be done with a view to the most speedy and perfect restoration of the injured structures.

1. MODE OF DRESSING WOUNDS.

The most important retentive means are adhesive plaster and sutures, aided, if necessary, by the bandage and attention to the position of the wounded parts.

There are various substances which are endowed with adhesive properties, and which are therefore well adapted to retain the edges of a wound in contact with each other. Those, however, which are usually employed for this purpose are the common adhesive plaster, collodion, and isinglass plaster.

The old *adhesive plaster* is composed of resin and lead plaster, in the proportion of one part by weight of the former to six parts of the latter, melted together over a gentle fire, and spread smoothly by machinery upon muslin, which is rolled up, and kept in the shops ready for use, care being taken to protect it from the heat. The addition of a little soap renders it more pliable, and prevents it from cracking in cold weather, without impairing its adhesiveness. To attain the same end, some pharmaceutists are in the habit of incorporating with it spirits of turpentine, but such an addition is highly objectionable, as the plaster, when thus prepared, is liable to irritate the skin, and thus induce a tendency to erysipelas and the development of small ulcers, to say nothing of the probability of its interfering with the adhesive action of the wound.

The plaster, when intended to be used, is cut into suitable strips with a pair of scissors, carried in the direction of the length of the cloth, not in that of its breadth, as it is much more yielding in the latter than in the former, and therefore liable, when it becomes heated on the skin, to let the edges of the wound gape more or less. Trifling as this precept may appear, I consider it to be of great practical importance, and am satisfied that it is much less insisted upon than it should be. When the wound occupies a limb, each strip should be long enough to extend about three-fourths round it; on no account should it completely encircle it, lest it obstruct the return of venous blood, and at the same time cause pain and tension. The width of each strip should be uniform, and should vary, on an average, from half an inch to an inch, according to the exigencies of each particular case.

Previously to applying the plaster, the surface of the skin should be divested of hair, and well wiped with a dry cloth, as the least moisture prevents it from adhering. The shaving of the parts is necessary to facilitate the removal of the plaster, which would otherwise be difficult and painful, and which might, by its traction, even seriously compromise the safety of the adhesive process. These important preliminaries being disposed of, bleeding having ceased, or nearly so, and the edges of the wound being carefully held together by an assistant, each strip is heated by holding its back against a pitcher or coffee-pot filled with boiling water, and then applied in such a manner as that its centre shall correspond with the wound, each extremity firmly grasping the opposite side. If the wound is very long and deep, the first strip should be stretched across its middle, which thus becomes the starting point of all the rest. The interval between each two strips should not, on an average, exceed the eighth of an inch, as this will afford ample space for the drainage of blood, serum, and lymph, of which there will generally be more or less after every injury of this description, especially if it be of considerable extent. Care must be taken that the adhesive strips are laid down in as smooth and even a manner as possible; hence, the parts should always be put in the position in which it is intended to keep them during the treatment. If the strips turn up in folds, or are partially detached, they should be immediately replaced by others, more skilfully applied. Finally, care must be taken, on the one hand, not to invert the edges of the wound or to draw them together too firmly, and, on the other, not to approximate them so loosely as to endanger their partial separation. In short, everything must be done in a neat, accurate, workman-like manner.

Much has been said of late years respecting the value of *isinglass* plaster; it is alleged that it is more bland than the common plaster, that it is quite as adhesive, and that it possesses the additional advantage of not provoking irritation, which the other undoubtedly sometimes does, especially in persons of a delicate, sensitive skin. Moreover, it is claimed that isinglass, when spread on gauze, will, by its transparency, admit of complete surveillance of the wound, thus enabling the surgeon to witness the changes going on in and around it. Notwithstanding these supposed advantages over common adhesive plaster, my conviction is that the latter, as prepared by the modern pharmaceutist, is decidedly superior to it, in every particular. The idea that common adhesive plaster is apt to cause erysipelas and ulceration of the skin is in great measure, if not wholly, chimerical; at all events, it has seldom fallen to my lot to meet with such occurrences. In the next place, it is much stronger than isinglass plaster, and therefore it affords better support to the parts. Thirdly, it is less liable to become prematurely detached; and, lastly, although it is opaque, yet as there is always an interval left between each two strips for drainage, it is obvious that it cannot in the slightest degree interfere with the examination of the wound and its vicinity. I, therefore, as a general rule, limit the use of isinglass plaster to the dressing of small wounds or little cuts, and employ the common plaster for wounds of large size. The principles regulating its application do not differ from those already laid down. The strips should be of appropriate length and width, and moistened on the glazed surface with a sponge wet with hot water.

The credit of having introduced *collodion* for surgical purposes is due to Dr. J. P. Maynard, of Boston, by whom it was first used in 1847. It is a solution of gun cotton in ether, assisted by a little alcohol, and is a transparent, colorless fluid, of a syrupy consistence, which, when applied to a dry surface, allows of the rapid escape of the ether, leaving a thin, bluish film, possessed of remarkable adhesive and contractile properties. Being impervious to water, it is less liable to be prematurely detached than isinglass or common resin plaster. Put upon wounds or abraded surfaces, it produces sharp pain, which, however, speedily subsides, and does not afterwards return. It may be applied by means of a camel-hair pencil, or a small brush, directly to the affected parts, as in the case of small, superficial cuts; or upon strips of silk gauze, or patent lint, of suitable width and length, when the wound is so large and deep as to require firm support. As the ether evaporates very rapidly, the dressing should be applied with as much celerity as possible, everything being thoroughly arranged beforehand, and the edges of the wound well dried and supported by an assistant. Personal observation induces me to believe that collodion makes an excellent dressing in solutions of continuity about the neck and face, or in all the more movable regions of the body, and in those cases where it is particularly desirable to exclude the contact of the air.

Within the last few years *caoutchouc* has been pressed into the service of the surgeon on account of its adhesive qualities; an excellent sticking plaster may be prepared from it by spreading a solution of it, with a stiff brush, upon gauze silk, or thin calico, after the fashion of collodion. One great advantage which it possesses over most other materials is that it is completely impermeable by water.

Whatever substance be employed, it should be allowed to remain on so long as it seems to answer the object for which it was applied. The moment, however, it becomes a source of irritation, loses its hold, or interferes with drainage, it should be removed; but before this is done the new substitute should always be in full readiness, so that the parts may not be unduly exposed to the air, before the dressing is renewed. Surgeons, I think, often err in being too anxious to meddle with the adhesive plaster; too early interference has a tendency to interrupt the adhesive process, and may, in persons of bad, irritable constitutions, give rise to erysipelas and other accidents. I have, more than once, after severe operations, retained all the adhesive strips for upwards of a fortnight; until, in fact, complete cicatrization had taken place. Such good luck, however, is rare; and it more generally happens that the dressings, plaster and all, have to be changed at the end of the second, or, at farthest, the third day. Much, of course, will depend, in every case, upon the state of the weather, the size and situation of the wound, and the amount and character of the discharges.

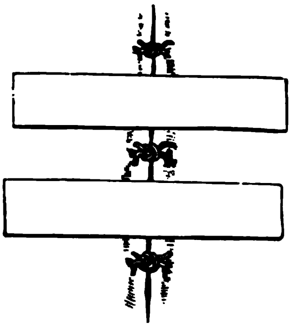
When the wound is extensive, only a few strips should be taken off at a time, otherwise we shall endanger the separation of its edges. Before the dressing is reapplied, the parts should be thoroughly cleansed with tepid water, pressed from a sponge held at some distance; no wiping must be done, nor must the wound be roughly squeezed. If there is matter at its bottom or between its edges, it should be pressed out in the most gentle and careful manner; all rough manipulation being not only painful but injurious to reparative action. Sometimes the necessary cleanliness may be readily effected with a moist sponge or soft cloth passed lightly over the surface. Great skill is required in removing the plaster to the best advantage of the parts. Each strip should be raised by taking hold of one extremity with the thumb and finger of one hand, while the other hand is engaged in supporting the wound; the other end being treated in a similar manner, the portion corresponding with the wound is lifted off last, and thus all danger of injury is effectually obviated.

The principal sutures employed in surgery are the interrupted, twisted, continued, and quilled. To these may be added the important modifications introduced by Professor Pancoast, namely, the plastic suture, as he terms it; the clamp suture of Dr. Sims; and the button suture of Dr. Bozeman; all of which will receive proper attention, in connection with plastic operations and the treatment of vesico-vaginal fistule.

The *interrupted suture*, which is more frequently employed than any other, is made with a needle, either straight, or slightly curved, and armed with a single, well-waxed ligature, either of silk or of linen, as may be found most convenient; for, in a practical point of view, it is really altogether immaterial which it is. The instrument, which should be very sharp, and spear-shaped, is introduced through the edge of the wound, from without inwards, at a suitable distance from its surface, and then pushed from within outwards at precisely the same point at the opposite side, leaving the thread in its track. A second stitch is then to be taken in a similar manner, and thus the operation is continued until a sufficient number has been introduced, when the ends of each ligature are to be tied with a reef-knot, and cut off close. The distance at which the needle should be inserted from the wound must of course vary in different cases and in different regions of the body; but, in general, it should not be less than half a line, nor more than a quarter of an inch.

The depth at which it is passed should be such as to admit of accurate approximation of the wound, about one-third of the thickness of the edge being behind and the rest in front of the needle. In no case of superficial wound should the instrument embrace muscular or aponeurotic substance. The interval between each two stitches must also necessarily vary, according to circumstances, from a few lines to an inch or more, and should be supported, after the sutures have been tied, with adhesive plaster, as seen in fig. 58. When the wound is very small, it may be sewed up with a common cambric needle, and a proportionately delicate thread.

Fig. 58.



The *twisted suture* is made by introducing a needle through the edges of the wound, and passing a thread round it, so as to confine it in its place. It makes an admirable retentive apparatus, but it is of more limited application than the interrupted suture. From the fact that it is generally employed in the treatment of hare-lip, it is often called by that name.

Various instruments are employed for making the twisted suture. The one to which I give the preference is what is called the lady's toilet pin, consisting of a round steel pin, very sharp-pointed, and furnished with a glass head; it readily penetrates the tissues, and creates less irritation than the common sewing needle, formerly so much employed for this purpose. Twenty-five years ago surgeons were in the habit of using a silver needle, with a movable steel point, as seen in fig. 59; a cumbersome, awkward instrument, now happily discarded. Dieffenbach recommended what is called the insect pin, which, however, has never come into general vogue, at least on this side of the Atlantic. In small wounds of the forehead, face, and neck, in which it is of so much importance to avoid a scar, I have been in the habit, ever since I entered the profession, of employing a very delicate gold pin, with a head of sealing-wax, and there is not, I am sure, any article better suited to fulfil such a purpose. Insusceptible of oxidation, it causes no irritation, and may therefore be retained an unusual length of time, without detriment to the parts.

Fig. 59.

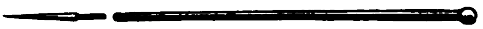


Fig. 60.

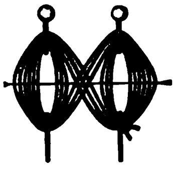
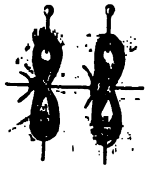
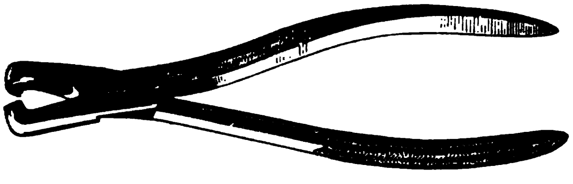


Fig. 61.



Whatever instrument may be employed, transfixion is effected in the same manner as in the common interrupted suture. The wrapping material is also similar, the thread varying in thickness according to the particular object to be attained. It is wound round the pin elliptically, as in fig. 60, as it arranges itself much more evenly and smoothly when thus applied than when applied in the form of an 8, as in fig. 61, and as recommended in the books. As many pins or needles having been inserted as may be deemed advisable, the threads are passed from one to the other diagonally across the gap, so as to effect complete apposition there also, and so obviate the necessity for using adhesive plaster. Finally, the ligatures being tied, the operation is completed by cutting off the points of the pins with a pair of forceps, delineated in the adjoining sketch, fig. 62, the object being to prevent them from hurting the patient, or being caught in his clothes.

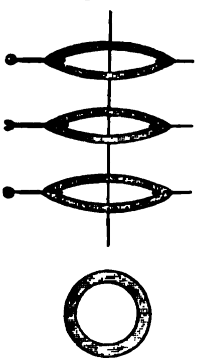
Fig. 62.



Pin pliers.

Instead of confining the pin with a thread, Mons. Rigal uses a thin narrow ring of gum-elastic, which answers the purpose most admirably, drawing the parts firmly and evenly together. The only objection to it is that it may cause too much pressure in the event of there being unusual swelling in the lips of the wound. Dr. Washington L. Atlee, of this city, has employed this form of suture in quite a number of his ovariotomy cases, and thinks it possesses decided advantages over the ordinary contrivance in that operation. The annexed cut, fig. 63, exhibits the shape and mode of application of the ring.

Fig. 63.



India-rubber suture.

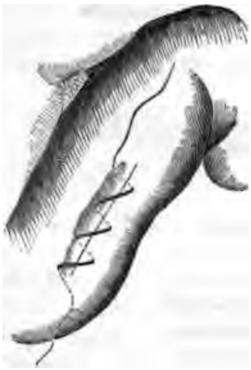
The time during which the pins are retained varies from thirty-six hours to three or four days, according to the circumstances of the case. Their removal should be effected with great care, in a direction contrary to that of their introduction, the parts being well supported at the time. The threads being generally firmly glued to the surface and edges of the wound, are allowed to remain until they drop off of their own accord, which usually happens in a day or two after. The support thus afforded is often of great service to the imperfectly organized bond of union, and its premature removal sometimes necessitates the employment of adhesive plaster, or the insertion of a new pin.

The *continued suture*, fig. 64, is similar to that used by the glover, on which account it is generally known as the glover's suture. It is made with a needle armed with a suitable thread, which is passed diagonally from one side of the wound to the other, on the same principle as in the interrupted suture. Its use is almost exclusively restricted to the treatment of wounds of the intestines, where it will again be noticed.

The *quilled suture*, fig. 65, so called from the fact that it was originally made with the assistance of two quills, is employed chiefly in the treatment of lacerations of the perineum, with a view of effecting more even and accurate contact of the opposed surfaces. The older surgeons were in the habit of using it in sewing up deep muscular wounds, as those of the thigh and abdomen. No one, however, thinks of resorting to it for such a purpose at the present day; for in the latter case, the object can be attained much more easily by the ordinary interrupted suture, extending down nearly to the peritoneum; and in the former by methodical support with the compress and bandage.

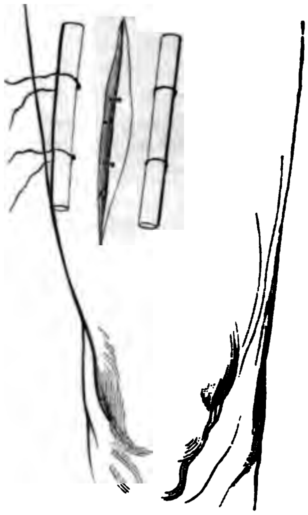
The quilled suture is made by passing a stout double thread through the sides of the wound, at intervals of an inch or an inch and a half, and tying its ends over a piece of bougie, quill, or wood, lying parallel with the (but about half an inch from it.

Fig. 64.



The glover's, or continued suture.

Fig. 65.



Quilled suture.

Although sutures undoubtedly act as foreign bodies, necessarily excitin certain degree of irritation in the tissues into which they are inserted, y have by no means that dread of them which they seem to have inspire the minds of many practitioners. It has rarely happened to me to wit any ill effects from their employment, and in those cases in which this e did happen the fault, I am inclined to believe, was due more to the indis tion of the surgeon, or the want of stamina on the part of the patient, t to any untoward operation of the sutures themselves. Provided the thre or needles and threads, are clean, of suitable size, and properly inserted; constitution of the patient in good condition; and the wounded structi in a tolerably sound state; it is difficult to understand how they could come a source of serious irritation, much less of erysipelas or severe ulc tion, effects which have all been charged to their action. My rule therefore always been to use them freely, and to allow them to remain as l as they seem to answer the purpose for which they were introduced. ' moment this object is attained, or they are found to be productive of inj they should be withdrawn.

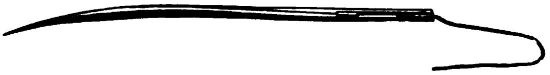
The best material for sutures is unquestionably metal, and it matters according to my experience, whether this is silver or iron, provided i properly tempered, perfectly smooth, and sufficiently pliant and thin. substance, although noticed in connection with this subject by diffe writers, was first introduced into regular practice by Dr. Sims, of New Y to whom too much credit cannot be awarded for what must be regarded every surgeon as one of the greatest additions to our armamentarium of present day.

The advantages of the metallic suture over every other are now so established, as to render it unnecessary to offer any comments in its fa It is sufficient to say that it is entirely free from all irritating properties, that it may be retained for weeks and even months without provoking s purative action, so common when silk or thread is employed.

The wire is introduced in the same manner as the thread, the short end being firmly twisted round the long one, in order to prevent it from slipping out of the eye of the instrument. Quite a number of needles have been devised for facilitating the insertion of the wire, but it is questionable whether they possess any particular advantage over the one in common use. Perhaps the most unexceptionable is one with two holes, with a vertical groove between them on each side. It is hardly necessary to add that the ends of the suture instead of being tied should be simply twisted together.

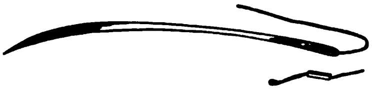
The annexed engravings will serve to convey an idea of some of the best forms of this kind of needles. Fig. 66 represents Mr. Price's instrument; it is grooved on both surfaces, and is pierced with two holes, nearly half an inch apart, the wire being passed from the lower to the upper, and then doubled and twisted at the end to hold it. Mr. Murray's needle, fig. 67, has a groove and open box end, while Mr. Lister's, fig. 68, has a single eye and a groove at the side. Ingenious contrivances of a similar kind have been constructed by Dr. Levis and Dr. Goddard, of this city.

Fig. 66.



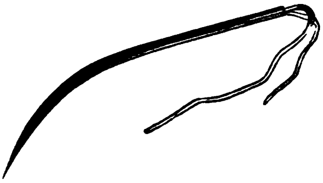
Price's needle for wire suture.

Fig. 67.



Murray's needle.

Fig. 68.



Lister's needle.

Some care must be taken in removing the wire suture, lest the edges of the wound should be forcibly separated. To prevent this the loop should be cut on one side very close to the edge of the wound, when the twist may be seized with the forceps, and the wire gently drawn out. The length of time during which the suture is retained must depend upon circumstances. From three to five days is a good average period.

Rest and easy *position* are essential elements in the treatment of wounds. If the part be exercised, or subjected to motion, it will be difficult, if not impossible, to preserve apposition, and to limit inflammatory action. If the wound be transverse, and seated in an extremity, it will be impossible to prevent it from being torn open, unless the muscles which pass along it are maintained in a relaxed condition. Thus, if the wound involve the front of the thigh, the limb is extended, and flexed if it affect the posterior aspect. In each case, the muscles immediately concerned in the lesion are put in a state of perfect repose.

In very large and deep wounds, it is hardly possible to keep the edges in contact, in their entire extent, without the aid of compresses and *bandages*. Let us suppose that the injury is seated in the thigh, and that it is accompanied by extensive division of the muscles. In such a case, adhesive plasters and sutures, however skilfully applied, would scarcely be sufficient to give the wound the support which is necessary to keep the deep portion of the edges in apposition with each other. More or less separation would almost be inevitable. To fulfil this indication, so important to the adhesive process, it is indispensable to lay a stout compress along each side of the limb, opposite the deep part of the wound, and to confine it with a roller, extending from the toes upwards as far nearly as the groin. In all wounds of this description, whether the result of accident or of operations, great care must be taken to prevent the retention of fluids, otherwise suppuration will take place instead of union by the first intention. Large intervals should be left between the adhesive strips, and holes should be cut in the bandage where it lies over the affected part; in some cases it will even be proper to leave a small tent at the bottom of the wound, bringing it out at the most dependent point, to drain off the discharges.

The most suitable bandage for supporting the wounded parts is the common roller, carried upwards from the distal portion of the limb to a short distance above the seat of the injury. The invaginated bandage, represented in figs. 69, 70, and formerly so much in vogue, is a dangerous contrivance, unworthy of scientific surgery.

Fig. 69.

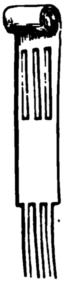
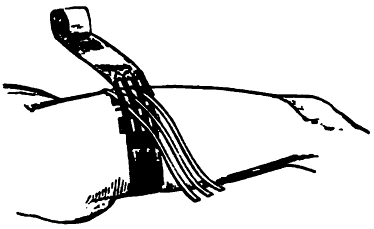


Fig. 70.



Invaginated bandage for longitudinal wounds.

2. MODE OF HEALING OF WOUNDS.

The parts having been properly adjusted, the duty of the surgeon, as far as manipulation is concerned, is temporarily at an end. Nature, the physician of wounds, as she was called by Paracelsus, must do the rest. "Warily," says this eccentric man, in his "Great Surgery," published in 1536, "warily must the surgeon take heed not to remove or interfere with Nature's balsam, but protect and defend it in its working and virtue. It is the nature of flesh to possess in itself an innate balsam which healeth wounds. Every limb has its own healing in itself; Nature has her own doctor in every limb; wherefore every chirurgeon should know that it is not he, but Nature, who heals. What do wounds need? Nothing. Inasmuch as the flesh grows from within outwards, and not from without inwards; so the surgery of wounds is a mere defensive, to prevent Nature from suffering any accident from without, in order that she may proceed unchecked in her operations." If these sentiments, uttered more than three centuries ago, could only be firmly impressed upon the mind of the modern surgeon, there would be much less meddlesome practice of every kind than there is now, notwithstanding our boasted knowledge, and our contempt for the fathers of the profession.

Modern surgeons have described five distinct modes according to which wounds are supposed to heal. The first is by immediate union, or the direct growing together of the raw surfaces; the second, by scabbing, or the formation of a crust of blood covering over the wound; the third, by the effusion of lymph, and the conversion of this into fibro-cellular tissue; the fourth, by granulation, and the development of epithelial matter; and the last, by the junction or inosculation of the granulations with each other. The old doctrine, so ably advocated by Hunter, and so long entertained by practitioners generally, assumes that there are but two modes of cure; the one consisting in union by the first intention, or primary adhesion, and the second in the formation of granulations, filling up the gap, and thus repairing the injury, the last stage of the process being the development of new skin. This latter mode of repair constituted what was so long known in the schools as union by the second intention, or union by granulation.

The idea that *immediate union* of a wound may take place was first advanced by Dr. Macartney, of Dublin, and is now prominently taught in all the British schools of surgery, if not also in those of this country. It assumes that two raw surfaces, laid closely and evenly together, will promptly coalesce with each other, independently of inflammation and effusion of lymph or blood, vessel inosculating, as it were, with vessel, muscular fibre uniting with muscular fibre, skin adhering to skin, and nerve becoming again continuous with nerve. It is alleged, it is true, that this occurrence is uncommon, and that it requires for its production a good constitution, an entire absence of local inflammation, and the greatest possible caution in respect to the management of the parts. When these conditions are present, it is asserted that even large wounds are capable of this kind of union; and a case, observed by Mr. Paget, is usually referred to as an illustration and proof of the possibility of such an occurrence. This case is briefly as follows: A female, aged thirty-three, had had her breast and several axillary glands removed on account of cancer. The flaps, which were very large, were carefully approximated, and kept in place with isinglass plaster; the general health seemed to be excellent, and union took place in the ordinary way, the whole line of incision having firmly closed by the end of the third week, except at one narrow spot, at which granulations arose from the pectoral muscle. Erysipelas and phlebitis now set in, and carried off the patient in four or five days.

"I cut off," says Mr. Paget, "the edges of the wound with the subjacent parts, expecting to find evidence of union by organized lymph, or, possibly, blood. But neither existed; and the state of the parts cannot be better described than by saying that scarcely the least indication remained of either the place where the flap of skin was laid on the fascia, or the means by which they were united. It was not possible to distinguish the relation which these parts held to each other from that which naturally exists between the subcutaneous fat and the fascia beneath it. There was no unnatural adhesion; but as the specimen, which is in the Museum of St. Bartholomew's, will still show, the subcutaneous fat which did lie over the mammary gland was now connected with the fascia over the pectoral muscle, just as, for example, the corresponding fat below the clavicle is naturally connected to the portion of the same fascia that lies there. The parts were altered in their relations, but not in their structure. I could find small points of induration where, I suspect, ligatures had been tied, or where, possibly, some slight inflammation had been otherwise excited; and one small abscess existed under the lower flap. But with the most careful microscopic examination, I could discover no lymph, or exudation corpuscles, and only small quantities of what looked like the débris of such oil particles or corpuscles of blood as might have been between the cut surfaces when the flaps were laid down. In short, we cannot otherwise or more minutely describe this healing than by the term "immediate union;" it is immediate, at once in respect of the absence of any intermediate substance placed between the wounded surfaces, and in respect of the speed with which it is accomplished."

No one, it seems to me, can examine the history of this case without being struck with the fact that it was just such an one as must, of necessity, have been followed by inflammation and a deposit of fibrin; the operation was evidently a severe one, the dissection was extensive, the relations of the parts were completely changed, and it is impossible to conceive that the flaps, although carefully laid down and confined by isinglass plaster, could have united without the intervention of plastic matter. If the use of the knife is ever productive of inflammation, it surely ought to be under such circumstances. That inflammation was present, is proved by the circumstances, referred to by the reporter, that there were several little points of induration apparently corresponding with the site where ligatures had been applied, and mention is also made of the existence of a small abscess, clearly denotive of the same fact. Thus, then, it is perfectly certain that both inflammation and deposit of lymph had occurred at several places, and it may be imagined, without any stretch of the imagination, that nature had treated the rest of the wound in a similar manner, with this difference only that less lymph was effused there than elsewhere. The union, too, was more prompt and effectual. Hence, long before the woman expired, the plastic matter, poured out as a consequence of the amputation of the breast, was completely absorbed, having fulfilled its purpose as a bond of connection between the opposed surfaces; so that, when the parts were examined with the microscope, not the slightest trace of it could anywhere be discovered. . Different textures, it is well known, possess different faculties of furnishing plastic matter, as well as of removing it after it has been deposited. Thus, in amputation of the leg, when the flap is exposed to the air, we observe that muscles, fibrous membrane, skin, and cellular tissue are much more rapidly glazed with lymph than adipose substance, vessels, or bone, the latter of which, in fact, rarely exhibits any evidence of its presence until the end of the first week, and then it always shows itself first on the medullary membrane, then on the cancellated structure, and lastly on the outer compact substance.

Now, if we take into consideration all the circumstances that can be brought to bear upon this question; the fact that all injuries whatever are followed by inflammation, if the patient survives their effects long enough, as well as by more or less effusion of lymph; that some structures take on this action more readily than others; that inflammation is often slight in one part and severe in another; and that lymph, when no longer of any use, is invariably absorbed, nature abhorring a substance which she does not need, as in the case of a wound after the completion of the solidifying process; taking, I say, all these circumstances into account, I am satisfied that it is impossible for any wound, however induced, situated, or treated, to heal by immediate union, or without the intervention of inflammation and effusion of lymph.

The only case, it seems to me, in which such a mode of union would be at all possible, is where the edges of a wound, as, for instance, one of the hand, are carefully approximated immediately after the receipt of the injury, thus affording the vessels and other structures an opportunity of promptly regaining their natural relations. But even here it is more rational to conclude that the vessels, irritated and fretted by the injury which they have sustained, would pour out a thin film of lymph, serving as a bond of reunion between the divided parts.

The second mode in which a wound is said to be capable of healing is by the process of *scabbing*, and here also, it is alleged, the cure is effected without the intervention of inflammation, or the deposition of plastic matter. An injury of this kind being inflicted, the blood coagulates upon its surface, where it soon forms a hard, solid crust, which thus protects it from the contact of the air and other injurious influences until it is covered over with new skin, when nature's shield, now no longer required, is cast off as an effete substance. This mode of healing is rare in man, but sufficiently common in the inferior animals, as the horse and cow, owing to their being so much less liable to active inflammation and its consequences. It is occasionally imitated by the surgeon's dressing, consisting of lint dipped in blood, or smeared over with collodion, so as to protect the raw surface from the contact of air and dirt. The principal proof deduced by the advocates of this mode of cure rests upon the supposed fact that inflammatory deposits occurring in a case of this kind would effectually destroy the process by prematurely detaching the scab, and so leading to the development of granulations, or union by the second intention. No one, however, has ever demonstrated that there is no inflammation when a wound is incrusted in this way; on the contrary, the whole theory is a mere speculation, unsupported by a single proof. The difference between such a wound and an ordinary open one, is simply this, that, in the former, there is very little inflammation, whereas in the latter, there is a good deal, but in neither is it wholly absent.

With regard to the third mode of cure, or union by *adhesive inflammation*, all pathologists stand upon the same ground, none disputing the possibility of its occurrence. The only conditions which it demands for its speedy and successful accomplishment are, first, that no coagulated blood shall intervene between the contiguous surfaces, and, secondly, that the part and system shall be maintained in such a state as not to permit the inflammation to transcend the limits of lymphization. According to this doctrine, union cannot take place without more or less inflammation and the effusion of a certain amount of plastic matter, serving as a bond of connection between the opposed surfaces, glazing and gluing them together, and ultimately, after having enjoyed the properties of nucleated blastema, assuming the character of cellulo-fibrous tissue. Now, if the views which it has been my object all along here to inculcate be correct, it follows that all union is the result of adhesive action; that is, of a certain degree of inflammation just sufficient, and no more, to pour out the requisite amount of coagulating lymph for effecting the cohesion of the raw surfaces. If the quantity of this substance is very small, or its vitality greatly impaired, no union will occur; nor will such an event take place if the effusion be attended with high excitement; for under such circumstances the lymph that is poured out will be aplastic and associated with suppuration, causing the parts to gap and compelling them to heal by granulation or union by the second intention. In the more favorable cases of adhesive inflammation, the intervening substance is soon removed by absorption, without being transformed into cellulo-fibrous tissue, which can only be needed when the union is tardy, or when it is effected through the medium of an inordinate quantity of plastic material; when, in short, the apposition has been somewhat imperfect, and yet not sufficiently so as to offer any serious obstacle to cohesion, or to cause suppuration. In general, when the process of reunion goes on kindly, the merest conceivable film of lymph is sufficient for the purpose; the vessels, nerves and absorbents soon extend from one side to the other across the intervening substance, and as soon as coalescence has occurred, and complete interchange has been established, the new matter, now no longer needed, is speedily removed, precisely in the same manner and for the same reason that the callus is removed after the union of a broken bone; nature, as already stated, being averse to letting anything remain that is not needed if she can get rid of it.

The fourth mode according to which wounds may heal is by the *granulating process*, or union by the *second intention*. This occurs in all cases where the adhesive inflammation is thwarted, whether in consequence of defective action, mismanagement, or any other cause whatsoever. The surface of the wound gaping, it gradually becomes covered with granulations, by which the cavity is ultimately filled up, cicatrization constituting the last act of the process. The manner in which these bodies are formed, as well as their structure and functions, having already been considered under another head, nothing further need here be said respecting them.

Finally, the new doctrine teaches that a wound may heal by the direct conjunction of granulations, or by a kind of *secondary adhesion*. This mode of cure, it is alleged, may occur whenever we place in contact the edges of an open wound, thereby bringing the granulations more closely in apposition, and so favoring their coalescence, coherence, or direct growing together. To my mind this mode of union does not differ from the ordinary process which we notice during the development, aggregation, and adhesion of granulations upon the surface of wounds and ulcers; hence, if this opinion be correct, such a distinction is as unnecessary as it is unscientific. I question, however, whether there is, in either case, anything like a direct adhesion; on the contrary, it seems more probable that whenever granulations unite they cohere through the medium of a thin film of plastic matter, as is the case with the raw surfaces of a recent wound, as previously described, and which is rapidly transformed into nucleated blastema, or germ cells, which thus form the basis of new tissue.

If what has now been said be correct, it follows, as a necessary corollary, that there are only two modes in which wounds unite, long recognized by surgeons, easily comprehended, and in perfect harmony with the results of observation and experience. These two modes are, as was previously stated, adhesive inflammation, or union by the first intention, and repair by granulations, or union by the second intention; in other words, there is no form of union without inflammation and lymph; and the only difference in the two processes here mentioned is that in the one the plastic matter serves as a direct bond of connection between the opposed surfaces, while in the other it is converted into a series of elaborately organized bodies which, by their coalescence, ultimately fill up the gap left by the retracted edges of the wound.

A subcutaneous wound heals on the same principle as an open one, only that, the contact of the atmosphere being prevented, there is less inflammation. Inflammation, however, is never, as some have asserted, entirely absent; for we always find after the operation of tenotomy, an operation which supplies us with one of the best examples of this class of lesions, that the parts continue to be sore and tender for some time afterwards, and that, as when the tendo-achillis has been divided, the person walks with great difficulty, or, as more generally happens, is altogether disinclined, if not actually unable, to move about. The lymph that is poured out here is highly organizable, and is therefore readily transformed, at first, into nucleated blastema, then into cellulo-fibrous matter, and ultimately into tendinous tissue, closely resembling that which it serves to unite.

SECT. II.—INCISED WOUNDS.

An incised wound is one inflicted with any sharp cutting instrument, as a knife, a sword, or an axe. It may vary in extent from the slightest possible incision to a gap of frightful length and depth. The largest lesions of this description are generally made designedly by the surgeon in the extirpation of tumors, in the amputation of the limbs, and in the resection of joints. In general, they are open, and therefore in contact with the air; but in some instances they are subcutaneous, and therefore exempt from such exposure. Every incised wound, however simple, is characterized by three phenomena, deserving of special consideration; 1st, by an effusion of blood; 2dly, by more or less pain; and 3dly, by a retraction of the edges of the divided structures.

1st. The *hemorrhage* varies in quantity, from a few drops to several ounces, or even quarts, according to the extent of the injury, and, above all, the vascularity of the affected tissues. When the capillaries alone are involved, the blood oozes rather than flows away, whereas the reverse is the case when a tolerably large vessel is divided. The hemorrhage may be strictly arterial, but in general it is both arterial and venous. In the former case the fluid is of a scarlet color, and spirts out in jets, synchronously with the contraction of the heart; in the latter, on the contrary, it is of a dark modena, or purple complexion, and issues in a continuous stream, as in bleeding at the arm. Some parts of the body being more vascular than others, are naturally inclined to bleed more when divided. Thus, a wound of the cheek bleeds more freely than one of the leg, and both less than one of the lip. Again, a part that has been habitually irritated for a long time will, when divided, emit a much greater amount of blood than it will if it be in a healthy state. A familiar example of this occurs in excision of the tonsils, an operation which is sometimes attended with profuse hemorrhage, in consequence of the enlargement of the vessels, and their inability to retract on account of inflammatory effusions.

2dly. The *pain*, like the hemorrhage, attendant on an incised wound, is influenced in its extent, by the size of the lesion, the nature of the affected textures, and the temperament of the individual. In general, it very soon subsides, and does not afterwards return, unless there is an undue amount of inflammatory action. When a large nerve has been implicated in the injury, there is usually, in addition, some degree of numbness in the surrounding tissues, and occasionally, also, partial paralysis in the distal parts.

3dly. The *retraction* of the edges of the wound is dependent upon the natural resiliency of the cutaneous and muscular tissues. It is very materially influenced, however, in its degree, by the depth of the wound, by its situation, and also by the amount of motion to which it may be subjected immediately after the receipt of the injury. Thus, a wound of the hairy scalp, extending down to the bone, will scarcely gape any, while one on the forehead, arm, or leg will exhibit a frightful cavity, in consequence simply of the muscular contraction of the part, or, in the case of the two latter, on account of the change of posture.

The *treatment* of such an injury is perfectly simple. The first object is to arrest the hemorrhage, provided this has not been already done by the natural efforts. In all cases where it is of a capillary character it soon ceases spontaneously; or, when this does not happen, it may be promptly stopped by exposing the surface of the wound to the cold air, or by pressing upon it a sponge wet with cold water. When, on the other hand, it proceeds from a vessel of considerable size, the more prudent course will be to apply the ligature; for, although it may be temporarily suppressed, yet it will be very liable to break out again upon the slightest exertion; or, at all events, as soon as reaction takes place. The manner of performing this operation will be pointed out under its appropriate head.

The hemorrhage having been arrested, the next thing to be attended to is the cleansing of the wound. Every foreign substance, no matter how delicate or minute, must be carefully picked away with the forceps, removed with the fingers, or dislodged with a stream of water, squeezed from a sponge. The finest hair, if allowed to remain, would act as an irritant, and impede the adhesive process. The same remark is applicable to the blood that may cover the wound, or incrust its edges. It is just as necessary to remove this as it is to remove dirt or any extraneous substance whatever. Even the slightest possible layer of blood is likely to prove a barrier to immediate reunion; for although it is unquestionable that this fluid may occasionally become organized, yet such an event is never expected or wished for under such circumstances. Hence the whole surface of the wound should be thoroughly freed of blood, not roughly, of course, but as gently as possible, before we attempt the approximation of its edges. If the blood has coagulated and become adherent to the wound, it may readily be detached with the fingers, forceps, or handle of the scalpel. Finally, the circumjacent parts, if covered with hair, are carefully shaved and washed.

The object of these preliminaries is to place the wound in the best possible condition for union by the first intention, or the establishment of the adhesive process. To insure this, the edges must be carefully approximated in their entire extent, and retained in contact for a certain period, by appropriate means, aided by rest and proper position of the part. If the wound be of small extent, nothing will be required beyond a strip or two of adhesive plaster. If, on the other hand, it is long and deep, it will probably be necessary to use, in addition, a few sutures, if not, also, a compress and bandage.

The wound being dressed, and the parts concerned placed at rest in a relaxed, and, if possible, also in an elevated position, little remains to be done by the surgeon, except to watch and assist nature in her reparative efforts. Within a short time after the edges of the wound have been approximated, inflammation is set up, and this is speedily followed by an effusion of plastic lymph, not only upon their surface, but also into the surrounding tissues. The interposed layer, hardly as thick as the most delicate spider's web, soon becomes organized, by an interchange of vessels and nerves between the opposite sides, and thus forms the bond of union between the divided structures. In the meantime the inflammation gradually subsides, the surrounding tissues regain their accustomed functions, and the consolidation is completely established. The resulting cicatrice remains rough for some time, but by degrees it becomes polished, and finally assimilates itself to the natural skin, except that it is whiter, free from hair and sebaceous follicles, and less capable of resisting the effects of disease.

But it is not always that the healing process advances so favorably as it has just been described. In many cases, indeed, it is materially retarded, interrupted, or even entirely prevented. Various causes may contribute to bring about this untoward result; of which the most common are the presence of some foreign body in the wound, or the want of accurate apposition of its edges, too much motion in the part, improper applications, or an undue amount of morbid action. It is the duty, therefore, of the practitioner not only to attend well to every case of the kind in the first instance, but to watch it most sedulously throughout its entire progress, inciting action when it is deficient, and repressing it when it is too high.

If the symptoms assume an untoward tendency, the adhesive action threatening to pass into the suppurative, the sutures and plasters should immediately be slackened, and recourse be had to the water-dressing, either warm or cold, simple or medicated, according to the tolerance of the part and system. In general, simple water will be found to answer better than anything else, and may often be advantageously employed from the very commencement, especially if the wound be very large, in anticipation of inordinate action. The diet, bowels, and secretions must be properly regulated; and if suppuration be inevitable, the most agreeable and soothing application will generally be a light emollient cataplasm. Gaping of the wound should be counteracted by the use of adhesive strips, aided by position, and, if necessary, by a few loose stitches and the bandage.

SECT. III.—LACERATED WOUNDS.

A lacerated wound is a lesion in which the tissues, instead of being smoothly divided by a sharp cutting instrument, are torn rudely and forcibly asunder. The edges are ragged and irregular, there is little pain or hemorrhage, and the surrounding parts, frequently bruised and discolored, are cold and benumbed. The injury most commonly occurs in factories, grist-mills, and steamboats, from the clothes and limbs being accidentally caught in the machinery. Extensive lacerations are often caused by weapons of war; by the teeth of the inferior animals, as the shark, dog, and bear; by the passage of the wheel of a cart or carriage; and by falls from a considerable height, in which the body strikes against a hard and projecting object, as a stone, a post, or an iron-railing.

A lacerated wound differs from an incised one, 1st, in the slightness of the attendant pain; 2dly, in its indisposition to bleed; 3dly, in its tendency to suppurate and slough; and, 4thly, in its liability to be followed by tetanus and other nervous symptoms.

The *pain* in lacerated wounds is generally very trifling; indeed, instances are frequently met with in which it is entirely absent, the patient being unconscious at the moment and for some time afterwards of having received any serious injury. Thus in the case of Wood, the miller, as detailed by Cheselden, the arm was torn off at the shoulder, and yet so slight was the pain that the man was not aware of what had occurred until he observed the limb moving round on the wheel. I have seen several instances in which the tendons of the fingers, along with a portion of their muscular bellies, were pulled out with such velocity as not to be productive of the least local distress, the patient not being conscious of having been injured until a short time after the accident. When the lesion is very grave and extensive, as when a limb is suddenly severed from the trunk, the attendant shock must necessarily be so severe as to obliterate, in great measure, all local sensation. Upon the occurrence, however, of reaction, the pain becomes frequently very violent, requiring large doses of anodynes for its suppression.

The absence of *hemorrhage* in a lacerated wound forms a very striking feature, and is the direct consequence of injury done to the vessels. In an incised wound there is no impediment to the flow of blood, because the vessels are divided evenly; in a lacerated one, on the contrary, they are torn into shreds and fragments, which readily intercept the fluid as it sweeps over them, and thus promote the formation of a coagulum, often extending high up into the tube. The vessels, moreover, are partially paralyzed, from the injury sustained by the nervous filaments of the affected parts; hence they are incapable of contracting upon their contents and of propelling them onwards. In addition to these circumstances, there is frequently, especially in severe lacerations, excessive prostration of the system, which powerfully contributes to the coagulation of the blood, and the formation of an internal clot. This indisposition to hemorrhage is present even when very large vessels are wounded. In the celebrated case of Wood, above alluded to, the arm was torn off along with the scapula, and yet there was no hemorrhage. Many instances of a similar kind have been published, among the more remarkable of which are those related by La Motte, Morand, Carmichael, Mussey, Gibson, and Allan.

Lacerated wounds are frequently deceptive in their appearance, the amount of injury being much greater than the surgeon is at first led to suppose. The skin, for example, may be affected very slightly, perhaps, indeed, hardly at all, while the muscles, aponeuroses, vessels, and even the nerves may be extensively severed, or torn up. In many cases the bones are crushed, large joints laid open, and the soft structures completely pulpified. Hence too much caution cannot be observed in our examinations, as well as in our prognosis.

The *treatment* of a lacerated wound is to be conducted upon the same general principles as that of an incised one. All extraneous matter is removed, the vessels, if necessary, are tied, the parts are neatly approximated, and every precaution is used to moderate the resulting inflammation. In applying the ligature, care is taken to select a sound portion of the artery, otherwise secondary hemorrhage will almost be certain to follow the sloughing process. When the hemorrhage is venous, it may, in general, be promptly and effectually arrested by the compress and roller, which should be so arranged as not to impede the return of the blood to the heart. All undue constriction must be avoided. Ligation is rarely called for, even when the largest veins are torn across. Although it is not probable, from the ragged character of the wound, that much of it will heal by the adhesive process, yet it is always best to treat the case with reference to this object. For this purpose the edges, after having been neatly trimmed, are lightly approximated, and maintained by adhesive strips, supported by a bandage; all tension is carefully avoided; and large interspaces are left between the plasters for the purpose of drainage. Sutures may usually be dispensed with, although I have not the same dread of them that some surgeons have; for I have, in many cases, derived the greatest benefit from their employment, while I have rarely seen them do any harm. They should never be retained longer than forty-eight hours, and they may be removed even earlier, if they appear to act injuriously. If any parts are entirely deprived of vitality, they may at once be cut away, but as there must generally be some uncertainty on the subject, it is a good rule to let them alone, and intrust their separation to the efforts of nature; or, at any rate, to wait until it is perfectly certain that they have perished.

To moderate the inflammation, the water-dressing is used, either warm or cold, as may best comport with the comfort of the patient. On the appearance of suppuration it may, unless acting very kindly, give way to the linseed cataplasm, which, in its turn, is superseded as soon as the granulating process is fairly established, by the opiate cerate. If the inflammation run very high, threatening to terminate in gangrene, purgatives and nauseants are freely used, and leeches applied to the parts immediately around the wound. The lancet is rarely required, except in very robust and plethoric subjects, in whom, under such circumstances, it cannot be resorted to too early or hardly too vigorously. Mercury is frequently indicated at the very commencement of the treatment, on account of the concomitant derangement of the biliary and digestive apparatus, produced by the shock of the injury. It should be administered in moderate doses, either alone or in combination with opium, Dover's powder, or morphia and antimony. Anodynes must be freely given to allay pain and insure sleep. Much judgment is required not to carry the depletion too far. In all cases due allowance must be made for the waste which must necessarily attend a wound of this description, as well as for the depression which the system experiences in the first instance, and which often continues to exert its baneful influence for days and weeks together.

Secondary hemorrhage may arise as soon as reaction takes place, or it may be postponed until the sloughs begin to separate. In the latter case, it will not be likely to occur before the fifth or sixth day. When there is reason to expect such an event, as there will be when a considerable sized artery is implicated, the patient should be most sedulously watched until the crisis is past, a tourniquet being placed loosely around the limb, and the nurse instructed in its use, so as to be fully prepared to meet the emergency the moment it arises. For the want of such precaution life might be destroyed in a few minutes, before it is possible for the attendant to reach the bedside.

many cases, if not generally, deprived of its vitality in the midst of the injured and perhaps pulpified tissues. When, however, the lesion is very slight, the vessels are sure to throw out more or less blood, although the flow is never copious, except when a considerable sized artery has been laid open, when it may be so great as to prove fatal in a few minutes. Much, then, will depend, in every case, as far as bleeding is concerned, upon the extent and particular character of the lesion sustained by the coats of the vessels, and also, but in a minor degree, upon the injury inflicted upon the blood itself.

Although there is frequently little or no bleeding in a wound of this kind immediately after its occurrence, yet there is generally, if the injury be at all extensive, great danger of secondary hemorrhage. The period at which this will be likely to happen is when the sloughs begin to separate, which, on an average, will be from the fifth to the tenth day, according to the size of the breach and the amount of the concomitant contusion. Hence, as in lacerated and gunshot wounds, the patient should always be diligently watched during this period, lest, hemorrhage coming on unexpectedly, he should perish before he can obtain assistance.

Contused wounds rarely heal by the first intention; the parts are too much bruised to enable their vessels to pour out plastic matter; the inflammation is often extremely severe, and the surgeon is fortunate if he can restrain it within the limits of suppuration, and prevent the occurrence of gangrene. The latter event is by no means uncommon when the lesion is at all severe, and there are few cases of the kind in which more or less tissue is not deprived of vitality during the infliction of the injury. Under such circumstances sloughing will of course be inevitable.

Lesions of this kind are often followed by large abscesses, particularly when they occur upon the scalp, on the hands and feet, and deep among the muscles of the thigh, abdomen, back, and shoulders. The pus is sometimes extensively diffused beneath the muscles, and is frequently preceded by erysipelatous inflammation, especially in nervous, irritable, and intemperate individuals.

Serious injury is occasionally inflicted upon the trunk or upon a limb, without any outward evidence whatever of the fact, perhaps not even the slightest bruise, scratch, or discoloration of the surface. Such accidents are most frequently caused by the passage of the wheel of a carriage, the kick of a horse, machinery in rapid motion, or the blow of a cannon ball, and are easily accounted for by the elasticity of the common integuments, which enables them to glide out of the way of the vulnerating body, while the other and deeper-seated structures, which are destitute of this property, are sometimes completely destroyed by its contact, the vessels and nerves being cut to pieces, the muscles torn into shreds, the bones mashed, and the largest joints laid open. The scalp is sometimes extensively detached from the cranium by a fall upon the head without any external wound, and a partially spent cannon ball, striking the belly obliquely, has been known to tear open the bowels, spleen, and liver, without leaving any mark or trace whatever upon the skin. Such injuries, which are, to all intents and purposes, subcutaneous wounds, are peculiarly severe, and are liable to be followed by the worst consequences; often proving fatal on the instant, or, subsequently, from the effects of inflammation.

Differing from the lesions now described are what may be called, in the strict sense of the term, *contusions*, that is, injuries of the organs and textures without any actual division of substance, except upon a small scale, implicating chiefly the more minute vessels and nerves, along with the connective tissues. Of this form of accident the "black eye," the result of pugilistic rencontre, affords an excellent illustration; as does also the bruise upon the scalp from a blow with a stick. The immediate effect of such an injury is an less it is perfectly clear that the tissues are dead, or unless they are so ragged and irregular as to render it impossible to effect accurate apposition. It will generally be well to intrust this matter to nature, permitting her to do as she may consider best.

A few sutures and adhesive strips are usually the only dressings that will be required. The parts, having been properly arranged, should be kept constantly wet with evaporating lotions, of which alcohol and water, in the proportion of one part of the former to five of the latter, will generally be the best. Weak solutions of acetate of lead or Goulard's extract will also be serviceable. Such cases are generally benefited by slightly stimulating applications, which seem to have the power of giving tone to the weakened vessels, and thus warding off erysipelas, which is so frequent a result of this lesion when treated in the ordinary manner. Leeches and iodine may become necessary when the inflammation is very active, and in this case too a poultice will generally be found to be more grateful than cold water or astringent lotions. The bowels must be maintained in a soluble state; but the greatest care must be taken to guard against severe purgation, and, in fact, against all active depletion. Due allowance must be made, in every case, for the profuse discharges which are so liable to follow contused wounds. If mortification should occur, the treatment will not differ from that consequent upon ordinary inflammation. Pain and nervous symptoms are controlled by anodynes and antispasmodics. When granulations begin to spring up, the milder ointments will come in play, and will advantageously supersede the warm and cold applications; the former proving now too relaxing, and the latter too repressing.

The removal of extravasated blood is best promoted by the tincture of arnica, in the proportion of three ounces to the pint of water, diligently applied with patent lint; and by cold astringent lotions, such as acetate of lead, Goulard's extract, alum, and hydrochlorate of ammonia. After the lapse of a few days, the part may be frequently bathed with spirits of camphor, or soap liniment; painted with the dilute tincture of iodine; or covered with a poultice made of crumbs of bread and common salt, or of the bruised roots of briony. Under this treatment an ordinary ecchymosis will often vanish in a few days; in the more severe cases a much longer time may be required.

When the extravasated blood appears in the form of a depôt, or as a concentrated collection, attended with marked tension of the integuments, the speediest way of getting rid of it is to make a small opening, just sufficient to permit the blood to drain off, if it be fluid, or to be squeezed out, if it be coagulated. The walls of the sac are then approximated by a compress and bandage, and irritation is kept down by the ordinary antiphlogistic means.

Cavalry-men and grooms are exposed to a severe form of contusion of the tibia, from the kick of the horse. The accident is liable to be followed by violent inflammation, with a tendency to erysipelas and diffused abscess. Recovery is often slow, and suffering great, especially if there has been much concussion of the bone, or extensive injury of the periosteum. The treatment is conducted upon general principles, with the addition of free incisions to liberate the soft parts, the knife grating against the surface of the bone, as in the operation for whitlow.

SECT. V.—PUNCTURED WOUNDS.

A punctured wound is a peculiar injury, deriving its name from the nature of the instrument with which it is inflicted, and the manner in which the tissues are divided. It comprehends all those lesions which are produced by nails, splinters of wood, thorns, pins, needles, pieces of bone, or fragments of glass: or by the thrust of a dirk, bayonet, lance, sword, or any other sharp-pointed weapon. The operation of tapping affords a familiar instance of such a wound. The sting of the bee, wasp, and other insects, and the bite of the snake, dog, rat, and other animals are all examples of this class of injuries, with this difference, however, that most of them are inoculated with the peculiar poison secreted by these creatures, and hence they naturally come to be considered separately. In common, every-day life, punctured wounds are most frequently met with in the hands and feet of the working classes. In dissecting and sewing up dead bodies the physician often punctures his fingers, and sometimes suffers severely in consequence, apparently, from the introduction of a peculiar septic virus, generated either during the act of dying or shortly after death.

Punctured wounds vary much in their extent, direction, and character; thus, they may be superficial or deep, narrow or wide, straight or crooked, simple or complicated; circumstances which will necessarily exert more or less influence upon their prognosis, treatment, and termination. Their depth is usually much greater than their width; hence it is often extremely difficult to determine the amount of injury done to the parts in which they are situated.

A punctured wound is peculiar, not only as it respects the mode of its production, but also in regard to its effects. The tissues are forcibly pressed asunder, and, consequently, more or less contused, if not also a good deal lacerated. The wound made by the bite of man and the inferior animals is usually both a punctured and a lacerated wound; so also when a splinter of wood, or a similar body, is violently driven into the flesh during an engagement on shipboard, or when a person is suspended by a hook or impaled upon a railing. A needle, nail, or bone, on the contrary, usually makes a purely punctured wound.

The *pain* attendant upon such an injury is frequently most excruciating, depending evidently, not so much upon the extent of the lesion, as upon the injury sustained by the nerves of the part, and the bruised and condensed state of the tissues. Hence the suffering, which is often immediate, is sure to be immensely increased if the resulting inflammation is at all severe. It is always greatest, other things being equal, in persons of a nervous, irritable temperament. Much also will depend, in this respect, upon the nature of the vulnerating body. The puncture, for example, made in the operation of tapping the abdomen with a trocar generally causes but little uneasiness, while that of a nail, penetrating the sole of the foot, deep down among the muscles, usually produces the most intense agony. Violent nervous symptoms often supervene upon such accidents, and in hot climates, as well as in the hot seasons in the colder latitudes, they are liable to be followed by tetanus, especially among negroes and the more intemperate classes of whites.

Punctured wounds are rarely attended with much hemorrhage, indeed frequently hardly any at all; if a large artery, however, has been penetrated, then the bleeding may not only be copious, but fatal, and that perhaps on the instant. The thrust of a sword, lance, dirk, or bayonet into the chest, abdomen. neck, or thigh, often literally taps the vessels, destroying the patient in a few minutes. The shock of such a lesion, too, may prove to be of consequence; even a slight puncture is sometimes followed by excessive prostration, and it has been found that soldiers, during engagements, are seldom able to continue the fight beyond a few minutes after they have been deeply pricked by the point of any of these weapons. The shock of the system is excessive, and the patient soon falls into a fatal syncope.

Another peculiarity of punctured wounds is their liability to be followed by *erysipelas*, angeioleucitis, abscess, contraction of the limbs, and wasting of the muscles. Mortification will not be likely to ensue unless the main artery or nerve of an extremity has been severed, or the system at the time of the injury is in a bad condition. Punctured wounds of the scalp, hands, and feet are particularly prone to be followed by severe nervous and inflammatory symptoms, and also by erysipelas, the latter generally coming on within less than thirty hours after the infliction of the injury. When the lymphatic vessels become involved, as they often do, the disease is indicated by a red line extending from the seat of the injury towards the nearest lymphatic ganglions. A similar phenomenon, along with more or less induration, is witnessed when the veins participate in the mischief; an occurrence by no means uncommon.

The secondary effects of punctured wounds are often very serious, entailing much suffering, with occasional deformity and loss of limb, and demanding much care on the part of the practitioner. Needles, pins, fragments of glass, and pieces of bone sometimes enter the tendons, ligaments, and aponeuroses, and causing severe and protracted irritation, ultimately lead to irremediable contraction.

The *treatment* of punctured wounds consists, first, in the extraction of the foreign body, in case it has not been already dislodged; secondly, in checking hemorrhage; and thirdly, in moderating inflammation and preventing the development of nervous symptoms.

To determine whether any extraneous matter remains in the wound, all that is necessary, in most cases, is simply to inspect the vulnerating body. If this exhibit marks of fracture, the probability is that a part of it has been left behind, if so, the probe and finger will assist in detecting it. Should the wound, however, be very deep and narrow, it may be necessary, before this can be done, to make an incision, the extent of which must depend upon the circumstances of each particular case, the only care to be observed being the avoidance of important structures, especially vessels, nerves, and tendons.

When a needle or other slender substance is imbedded in the flesh, or buried in the cellular tissue, we may often succeed in detecting it by folding up the skin over it, or making gentle and systematic pressure with the ends of the forefingers at its supposed site, which is generally indicated, at least in recent cases, by a little puncture, perhaps not as large as a flea-bite, upon the surface. Sometimes the local pain or tenderness affords valuable information as to the precise spot where the needle is lodged. I never hesitate, when there is reason to believe that the foreign body has been retained, to make, if necessary, a free incision for the purpose of extracting it; it is much better to do this at once than to temporize with the case, and to wait until bad symptoms arise, when such a procedure becomes inevitable, although it may now be too late to prevent altogether its bad effects.

In the sole of the foot pieces of bone, glass, and other small bodies are sometimes buried deeply beneath the plantar aponeurosis, where it is often quite impossible to detect their presence, however carefully searched for. I well remember a case of this kind which fell under my observation many years ago, in a most interesting boy, nine years old, who lost his life from this cause. As he was running about barefoot one morning, he trod upon a chicken bone, a fragment of which, nearly an inch long, entered the sole of the foot, lodging deeply in the substance of the flexor muscles, in contact with the metatarsal bones. Pain and swelling followed, but still the boy walked about for upwards of a fortnight, limping of course; the weather, in the meantime, being excessively hot. Suddenly symptoms of tetanus came on; Professor Willard Parker, then my colleague, and I now saw the case, and, although we made every effort to discover the foreign body, yet such was the swelling of the part and the depth at which it was situated that we could not detect it. Death followed in a few days, when we found it so completely buried that it required a very elaborate dissection to remove it.

The bleeding in punctured wounds generally ceases spontaneously; if a large artery has been laid open, or divided, it must be exposed, and tied at each extremity, in the usual manner. If this cannot be done, compression may be tried, as in the treatment of aneurism; or, this failing, or not being deemed admissible, the main trunk of the vessel is tied at some distance from the injury.

To prevent the occurrence of severe pain and nervous distress a full anodyne should always be given, if the case be at all severe, immediately after the accident, and the part wrapped up in flannels, wrung out of warm water and laudanum and frequently renewed. If the general health suffer, a dose of calomel should be administered, followed by oil or senna. If fever arise, the antimonial and saline mixture with morphia may be required, to act on the skin and bowels, and to allay pain and induce sleep. If matter threaten to form, as indicated by the tension and throbbing of the part, free incisions must be made; erysipelas, angeioleucitis, and phlebitis must be treated in the usual manner. Nervous symptoms must be met with the liberal use of morphia and tartar emetic.

Along our Indian borders very severe wounds, of a punctured character, or partly of a punctured, and partly of an incised nature, are often inflicted with the *arrow*, which, as is well known, is capable of being projected, with extraordinary precision, to a great distance. Being usually made of the young willow, or other suitable wood, it varies in length from two feet to two feet and a half, and is feathered in the greater part of its extent, in order to facilitate its movements and increase its speed through the air. The head is generally furnished with a spear-shaped piece of flint, obsidian, or iron. This, which is technically termed the point of the weapon, is of a flattened conical figure, its length from base to apex ranging from three-quarters of an inch to an inch and a half; the corners, or angles, project in a line with the side of the free extremity, and are usually upwards of an inch in width, the whole arrangement being such as to enable the instrument to operate on the principle of the barb of a fish-hook. Thus constructed, the point is securely fixed in a notch on the head of the arrow by means of the tendinous shreds of the deer, coated over with the resin of the fir-tree.

It is supposed that many of our Indian tribes poison their arrows, so as to inflict a more deadly wound; but I am informed by an old pupil, Dr. William F. Edgar, of the army, that this practice is peculiar to the savages inhabiting the mountainous regions watered by Pitt River, one of the northern branches of the Sacramento. These people, it is said, use the poison of the rattlesnake, by grinding the dried head of that reptile into an impalpable powder, which is then applied by means of the putrid blood and flesh of the dog to the point of the weapon, the wound of which proves speedily mortal.

Dr. T. C. Henry, an army surgeon, writes me that wounds made by arrows often partake of the nature of incised wounds, or of those caused by the thrust of the small sword. The iron heads of these weapons are exceedingly thin, and being propelled with great force, make a clean cut, a portion of which not unfrequently unites by the first intention. Unless an important vessel is laid open, such wounds seldom bleed much. Sometimes the head of the arrow is broken off deep in the flesh, thus requiring a tedious dissection for its removal.

SECT. VI.—TOOTH WOUNDS.

Wounds inflicted by the bite of the human subject and of the inferior animals, as the dog, cat, or rat, partake of the nature of contused, lacerated, and punctured wounds. Such lesions are by no means uncommon, and, from the danger which so often attends them, are worthy of more attention than they have hitherto received. I have seen quite a number of cases of severe suffering occasioned by wounds received upon the fingers in the act of striking persons upon the mouth. The inflammation consequent upon such injuries is prone to assume an erysipelatous character, especially if, at the time of the accident, the constitution happened to be in a deranged state, and it is sometimes so violent as to be followed by mortification. In 1851, a distinguished jurist struck a man upon the mouth, wounding his finger slightly against his teeth. Erysipelas promptly supervened, and the hand had to be amputated; subsequently the disease reappeared in the stump, and necessitated the removal of the arm.

The following cases will serve as illustrations of this class of injuries, of which I believe no account has yet appeared in any of our systematic treatises on surgery.

Mary Jackson, aged 47, always in good health, struck the back of her hand against the tooth of a servant girl, producing the merest scratch of the skin over the knuckle of the right index-finger; the part bled only a few drops, and caused hardly any pain at the time. Within two hours afterwards, however, it began to throb and ache, the pain extending up the hand, and thence gradually up the limb as far as the axilla, where considerable enlargement of the lymphatic ganglions soon took place. The forefinger swelled rapidly, and to an enormous degree; the hand and arm were also much tumefied, and a deep red line was seen passing along the limb. Great constitutional disturbance came on, attended with loss of sleep and appetite; and a large abscess formed in the theca of the finger, followed by necrosis of the last phalanx and anchylosis of the other joints. The whole limb remained for a long time sore, tender, and swollen, and upwards of a year elapsed before the re-establishment of the general health.

James Black, aged 36, farmer, eight weeks ago struck a man upon the mouth, receiving a superficial abrasion over the knuckle of the little finger of the right hand. Violent erysipelas of the whole limb followed; the finger became enormously swollen, and a large abscess formed in it, eventuating in the death of its phalanges. The general health suffered greatly, and a fresh attack of erysipelas broke out after the amputation of the finger. Many months elapsed before final recovery occurred.

A medical gentleman, upwards of seventy years of age, received a small wound upon the left index-finger by striking a negro lad upon the front teeth. Erysipelas soon showed itself, attended with exquisite pain, and extending up the limb beyond the elbow. After much suffering, in which the constitution seriously participated, the inflammation at length disappeared, leaving the finger stiff, crooked, withered, cold, and benumbed.

Thomas Clark, aged 47, farmer, in good health, struck a man on his mouth, on the 24th of December, 1851, the knuckle of the metacarpal bone of the right ring finger coming in contact with the incisor teeth; the skin was slightly broken, but he experienced no pain at the time. The same evening, however, the hand and finger became painful and stiff, and the next day they began to swell and to present an erysipelatous appearance. Excessive suffering ensued, producing profound constitutional disturbance; and finally, in about three weeks, a large abscess formed in the hand, requiring the lancet.

When I first saw the case, at the end of this time, the thumb and all the fingers were stiff and immovable; the wrist-joint was also much affected, and, in fact, the whole limb was sore and painful. In August, 1852, the thumb and fingers were still rigid and useless; much colder than natural, benumbed, and considerably attenuated. Every attempt to bend the fingers was attended with severe suffering. The right ring-finger was anchylosed at the metacarpo-phalangeal joint. There was still much uneasiness in the palm of the hand. The whole limb had an atrophied appearance.

The bite of the human subject is often followed by violent symptoms, coming on soon after the infliction of the injury. I have witnessed quite a number of such cases, and in several have experienced much trouble in saving limb and life. I do not presume that the saliva has anything to do, in this class of wounds, with the production of the bad effects by which they are so liable to be succeeded; the parts are badly bruised, or bruised, lacerated, and punctured, and we well know how prone such injuries, however induced, always are to be followed by erysipelas and other serious consequences, especially when they occur in persons of intemperate habits, or disordered health.

The bite of the inferior animals, particularly when they are much enraged, is often succeeded by a very bad form of erysipelas. Many years ago I attended, along with Dr. Trimble, of Ohio, a child, about three years of age, who had been bitten in one of his fingers a short time previously by a rat. A severe attack of erysipelas soon came on, involving the whole hand and forearm, and causing the most violent local and constitutional suffering. The bitten part was converted into a large unhealthy ulcer, discharging a thin, sanious fluid, and was a long time in healing. Recovery finally took place, but not without permanent anchylosis of the finger, and partial atrophy of the hand and forearm. The bite of the dog, cat, and horse is liable to be followed by similar results. In India the slightest bite of the camel is said frequently to occasion severe inflammation and great general disturbance.

The treatment of tooth wounds and abrasions must be conducted upon the same general principles as ordinary contused and punctured wounds. I would strongly advise, however, that the part should always be well cleansed and bathed with warm salt water, to get rid of any saliva and other matter that may have been deposited by the teeth; after this the best application will be a lead and laudanum poultice, followed, if necessary, by leeches, and, if matter form, by early and free incisions. The dilute tincture of iodine, pencilled over the inflamed surface around the wound, will also be useful. The best internal remedies will be calomel and opium, with an active purge at the commencement of the treatment. When the case is obstinate, alteratives and tonics with change of air may be required.

SECT. VII.—GUNSHOT WOUNDS.

Gunshot wounds are injuries inflicted by fire-arms, as pistols, muskets, rifles, carbines, cannons, shells, and rockets; and are dangerous or otherwise according to their extent, the nature of the affected structures, and the state of the system at the time of their receipt. Occurring in all parts of the body, they may, in one case, be so slight as hardly to attract serious attention, while in another they may be so severe as to cause death upon the spot, either in consequence of shock or loss of blood, or, secondarily, from the violence of the resulting inflammation. Even when the person is so fortunate as to escape with his life, he often remains miserable ever afterwards on account of his mutilated condition, the repeated formation of abscesses, or the occurrence of neuralgic pains, which, hardly leaving him any respite from suffering, keep his mind and body in a state of constant irritation, and utterly incapacitate him for enjoyment and useful exertion.

The wounding missiles which are generally employed in civil life, in this country, are pistol, rifle, and musket balls, varying in their volume from that of a body but little larger than a swanshot to that of a small marble. Until recently the ball in use in the American army was the round musket ball, which, with a view to greater efficiency, has been superseded by what is called the new rifle-musket ball, the weight of which is 500 grains. It is of a conical shape with a square hollow base and three grooves; and when fired with a charge of sixty grains of powder, at a distance of 200 yards, penetrates eleven one inch pine planks, placed one inch and a half apart. At the distance of 1000 yards it penetrates three and one-fourth of such planks.

The British, French, and Russians employ a considerable variety of balls adapted to the peculiarities of their respective services. The Enfield ball, used by the English since 1853, is rapidly superseding all other missiles of that description. It is a long conical ball, hollow in the base, weighing ℥j and ℈ij. The French Minié ball weighs ℥j, ʒij and ℈ij. The Russian ball, also conical, weighs ℥j and ʒvj.

It has been found in military operations that the conical ball, while it meets with much less resistance from the atmosphere than the round ball, passes to a much greater distance, and does more terrific execution upon entering the body, generally passing in a straight line, and fracturing and comminuting the bones in a most fearful manner; thus causing a much greater mortality, as well as a more frequent necessity for amputation.

The conical ball, moreover, is less liable to become flattened and divided than the round ball, and the aperture of exit is nearly always opposite to that of entrance, which was not so often the case formerly. It is alleged that much of the gravity of gunshot wounds in the Crimean war arose from the substitution of the conical bullet. To show with what power the Minié ball occasionally does its work, it may be stated that it has been known to pass through the bodies of two men and to lodge in that of a third standing some distance behind.

Sometimes two balls are united by a piece of lead, and put in a cartridge, thus producing, when fired, a terrible wound, as often happened in the Schleswig-Holstein war. The Russians in the Crimea also caused great mischief by this expedient. In the naval action off Camperdown, in 1797, great destruction was wrought by the Dutch, by firing bags of nails and pieces of old iron.

Cannon balls are made of cast iron, and range in weight, on an average, from one to sixty-four pounds, the larger being chiefly used at sea and in beating down batteries, and the smaller in field-service. Grape-shot are small balls, confined in a canvas bag, arranged round a wooden spindle by means of a cord, the whole bearing a faint resemblance to a bunch of grapes, whence the name. From this the canister-shot differs principally in being contained in a cylindrical tin-case, closed at each extremity with a piece of wood. Both these classes of missiles are accurately fitted to the caliber of the guns from which they are intended to be discharged. "Shells are large hollow spheres of iron loaded with gunpowder, which may act either in their entire form as solid balls, or subsequently by the explosion of their contents, and their subdivision into numerous splinters, by which their ravages are greatly extended. Shrapnell shells, so named from their inventor, are hollow spheres, loaded partly with gunpowder, partly with balls."

A pistol ball, if fired near, inflicts quite as deadly a wound as a musket or rifle ball. This missile is now generally of a conical shape, and operates with great effect, both upon the soft and hard structures.

A buck-shot wound is at present of rare occurrence. During the late war with Great Britain it was sufficiently common. Buck-shot are sometimes inclosed in wire cartridges, and are then very effective, carrying close for twenty yards, diverging somewhat at fifty, and entering separately at one hundred and fifty, readily penetrating a yellow pine board an inch thick.

Small *shot*, striking the body in a concentrated form, are capable of producing the same effect as a large bullet; if they are scattered, the injury will be less grave, unless they happen to hit an important organ, as the heart, brain, or spinal cord, when death may ensue in a few minutes, or, more remotely, from the resulting inflammation, as in several instances which have fallen under my own observation. Lachèse has ascertained by numerous experiments that a load of small shot discharged at a dead body, at a distance of ten inches, will make a clean round opening; at from twelve to eighteen inches the opening will be very irregular and ragged; whereas, at thirty-six inches, the shot will be scattered in such a manner as to enter separately, not making a common opening at all.

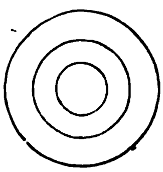
Grave injury is sometimes inflicted by the explosion of *percussion-caps*. Such accidents are sufficiently common among sportsmen, whose pleasures of the chase are often requited by the loss of an eye, and by the most excruciating suffering, from the lodgment of a piece of the foreign body in one of the chambers of that organ, or in the substance of the iris.

Persons are occasionally killed with *wadding* discharged from an ordinary fowling-piece. An instance occurred, some years ago, in one of our theatres where a man lost his life from this cause in a sham-fight upon the stage. The wadding, which was a common cartridge, struck the side of the head, fracturing the temporal bone, and passing across the brain, lodged against the falx of the dura mater, from which it was extracted by Dr. John Rhea Barton after death, which happened in an hour after the accident. In 1838, a girl was killed in England by the discharge of a gun loaded with paper pellets, some of which penetrated the body and lodged in the lungs and liver. In two other cases life was destroyed by a single pellet; in one, by laying open the fifth intercostal artery, and in the other by breaking the orbitar plate of the frontal bone, and injuring the brain. A case is recorded of a man being fatally wounded by a kid-glove with a button attached to it; it was discharged from a blunderbuss, loaded with powder, and struck the person, who was standing ten feet off, upon his abdomen, in the cavity of which it was found on dissection.

It is well known that *gunpowder* alone, without any wadding, may, when discharged near the body from a gun, pistol, or fowling-piece, cause fatal injury. From the experiments of Lachèse it appears that, when the distance does not exceed six inches, and the weapon is large and strongly charged, the wound thus made will bear some resemblance to that produced by small shot, each particle which escapes combustion acting like a pellet. The fact that the mere explosion of powder near the body is capable of causing severe bruises, contusions, lacerations, and even death, has long been familiar to observers. The instances are quite numerous of great suffering, mutilation, and disfigurement having been produced by the lodgment of grains of powder in the eyes, face, neck, and other parts of the body. Stone quarriers are particularly liable to such accidents.

In its character, a gunshot wound partakes of the nature of a contused and lacerated wound; at the opening of entrance and for some distance around, the tissues are bruised, but as the ball passes onward it tears the parts, and at the opening of exit they often look as if they had been cut with a sharp knife. The effects of the transit of the missile upon the soft textures may be explained, as was first suggested by Sir Charles Bell, by a reference to a diagram consisting of three concentric rings, as in fig. 71. The first, including the tubular wound, is bounded by tissues which are so compacted, condensed, or contused as to deprive them, to some extent, of their vitality, or, at any rate, to place them in such a condition as inevitably to lead to suppuration; consequently this portion of the wound seldom unites by the first intention. The structures between the first and second rings, having sustained less injury, will also inflame, but only, as a general rule, in such a manner as to give rise to a deposit of lymph, or lymph and pus; while those beyond the last circle will either retain their natural properties, or, becoming excited, will merely experience some slight serous infiltration.

Fig. 71.



The above phenomena may generally be studied to the greatest advantage in deep flesh wounds, as those of the thigh. In such cases there is often a considerable slough of the bruised tissues, upon the separation of which the parts are seen to suppurate and to form granulations, while farther on they are hard, next œdematous, and beyond this natural. These phenomena, however, do not generally pervade the entire length of the wound; for it frequently happens that a considerable portion of the track unites by adhesive action, the tissues being lacerated instead of contused, as they are in the early stage of the passage, and consequently favorable to restoration. The precise point where the tubular wound loses the character of a contusion and assumes that of a laceration cannot generally be ascertained; it will of course vary very much in different cases, and under different circumstances.

The preceding remarks in regard to the injury inflicted by the projectile are chiefly applicable to the smaller kinds of balls, such as the pistol and rifle; the larger ones are generally productive of more serious mischief, and hence it often happens that the wound sloughs in its entire length, from the opening of entrance to that of exit; there being afterwards, when the dead parts have separated, extensive and tedious suppuration, the matter, perhaps, burrowing deeply among the soft structures, and thus greatly retarding the process of repair.

Disposition of the Projectile.—The manner in which the projectile is disposed of varies; sometimes it lodges, and then, of course, it makes but one opening; at other times it passes completely through the part, and so leaves two apertures, one of entrance, and the other of exit. Cases occur where one ball may make three, four, or even more holes. Thus, if it should happen to encounter a sharp edge of bone, as the crest of the tibia, it may be cut into two or more pieces, each of which may afterwards issue at a separate point. Dupuytren met with a case in which a ball, cut into fragments, made five orifices; and at Antwerp the younger Larrey saw six holes made in a similar manner. Again, a ball piercing the surface, just above the wrist, may be unable to penetrate the aponeurosis of the forearm, but, travelling along for some distance under the integument, may emerge below the elbow; then, the limb being considerably flexed at the moment, it may re-enter the skin a second time at the lower part of the arm, and finally escape near the shoulder-joint; thus leaving four apertures, two of entrance, and two of exit. Such an occurrence is, of course, quite rare; but its possibility should not be forgotten, as it is of great interest in a medico-legal point of view. A man, for example, might be shot in a duel, and his friends seeing the number of openings in the limb, might accuse his adversary of foul play, on the ground that he had used more than one ball.

A ball striking an extremity may pass not only completely through it, but also through its fellow, thus making four openings; or it may perforate the upper part of the thigh, and then pass through the head of the penis, leaving two orifices in the former and two in the latter, as in a case which I saw in the Hospital at Alexandria, under the care of Dr. Sheldon, after the engagement near Centreville, Virginia, on the 18th of July; or, finally, it may traverse both buttocks, or it may perforate one and lodge under the integuments on the outer side of the other, as in a man who was wounded in the battle at Bull Run.

When there is but one opening, it is natural to conclude that the ball has lodged, and this, as already stated, is usually the fact. Instances, however, occur, although they are very rare, where the reverse is the case. Thus, a ball has been known to pass for some distance into the pectoral muscle, and to be immediately ejected by the recoil of a rib. The knee-joint has occasionally been opened, the ball being supposed to have lodged in the head of the tibia, but upon amputating the limb no ball was found, although there was but one opening. Lastly, a ball may enter the body, perhaps rather deeply along with a piece of cloth, upon extracting which the missile may drop out. Instances, illustrative of the possibility of all these occurrences are circumstantially narrated in the admirable and instructive works of Percy, Guthrie, Hennen, Baudens, Macleod, and other military surgeons, and deserve an attentive perusal.

Large balls, fragments of shell, pieces of iron, and other substances, occasionally bury themselves deeply among the muscles, where, owing to the small size of the opening made on entering, they have been known to remain for a long time without exciting any suspicion of their presence. Larrey narrates a case in which he extracted a ball, weighing five pounds, from the thigh of a soldier, who had suffered so little inconvenience from it that it had been entirely overlooked by the surgical attendant; and Hennen refers to a similar instance as having occurred at Seringapatam. Here, however, the ball weighed twelve pounds.

Considerable difference generally exists between the *openings* of entrance and exit. The former is usually rounded with even or slightly inverted edges, as if the skin had been tucked in a little, and there is frequently more or less bluish or blackish discoloration of the adjacent surface, from the contact of burnt powder, deposited upon the ball at the moment of the explosion, and rubbed off as the ball strikes the body. When the discharge takes place within a few feet of the surface, scorched grains of powder often adhere to the skin, or are even imbedded in its substance. The opening of exit, on the contrary, has generally a slit-like appearance, looking rather as if it had been made with a sharp knife than an obtuse body; it is free from discoloration, and its edges, instead of being inverted, are turned out. I have met with cases where both openings had an incised appearance, but such a condition is rare.

The size of the two openings is variable. In general, the round ball will make a larger orifice of entrance than of exit, the reverse happening when the injury is inflicted with the conical ball. These peculiarities were remarkably apparent in the wounds of the Federal troops after the battle at Bull Run, on the 21st of July last. I had occasion also to notice the immense size of the openings in gunshot wounds of the integuments, made by the conical ball, especially when the two apertures were close together. In nearly all the cases of this class of lesions that I saw in the hospitals at Alexandria, Washington, and Georgetown, the holes, especially that of exit, were disproportionately large, as well as remarkably irregular and ragged.

Shell wounds, and wounds inflicted with stone, nails, splinters, and similar missiles, always exhibit a lacerated appearance, owing to the irregular shape of the vulnerating body. A similar character is often imparted by flattened bullets.

A ball, flying in a straight line, under a strong impetus, will, on reaching the surface of the body, penetrate it in the same direction, dividing all before it in the cleanest and neatest manner, even to the bones, and probably issuing at a point directly opposite. If, on the other hand, its force is partially spent, then it will either not enter at all, or, if it do, it will be turned out of its course, the slightest resistance, as that offered by a tendon, ligament, or aponeurosis, serving to change its direction. The circumstances which tend to weaken the force of a ball are two, the attraction of the earth and the resistance of the atmosphere. It has been ascertained that a strong wind blowing perpendicularly to the direction of the American rifle-musket ball, will deflect it from its course 12 feet in 1000 yards, about one-fourth that distance in 500 yards, and about six inches in 200 yards. Besides, its impulse may receive a serious check by coming in contact with the person's accoutrement, or some article of dress, as a button, or breast-plate, or some substance that may happen at the time to be in his pocket, as a key, pencil, knife, watch, or piece of coin. If, from these, or any other cause, the force of the projectile is partially spent, it may, on reaching the surface, either glance off; or, if it enter, it will be likely to be deflected; and the course which it sometimes pursues under such circumstances is very remarkable. Thus a ball has been known to pierce the forehead, but instead of penetrating the frontal bone, it has passed round the skull, underneath the scalp, and lodged upon the occiput, at a point nearly opposite to that of entrance; or, what is still more extraordinary, it has travelled nearly completely round the head, issuing only a short distance from the place where it struck. In the same manner a ball has been found to describe the circumference of the chest, its course being marked by a reddish weal or line. Several well authenticated cases are mentioned by writers on military surgery where the missile, piercing the wall of the chest by the side of the sternum, made the circuit of the thoracic cavity by passing between the costal and pulmonary pleuræ, and either falling down upon the diaphragm, or lodging in the wall of the chest behind, without inflicting the slightest injury upon the lung. Examples of a similar kind occasionally occur in the abdomen, the ball, after entering the skin, being turned out of its direction by the tendon of the external oblique muscle, so as to pass round the belly beneath the integuments, and effect a lodgment near the spine, or, perhaps, escape somewhere upon the back. Finally, cases are not wanting, although they are certainly rare, where a ball has entered the abdomen in front, and issued behind, in a straight line, without wounding any of its contents. Such occurrences might challenge credibility, if the authors who have related them were not, from their high position and character for veracity, entitled to implicit confidence in their statements. They find their counterpart in sword, bayonet, and dagger wounds of the abdomen, in which the walls of that cavity are sometimes completely transfixed, and yet its contents escape unharmed.

A case is related by Dr. William H. Herring, of the army, where a musket ball, entering the superior and posterior part of the neck, was discharged at the end of five months by the anus, having, as was supposed, passed by ulceration into the pharynx and thence into the stomach.

Different tissues possess the faculty of deflecting balls in different degrees. Thus bone offers a greater amount of resistance than cartilage, cartilage than tendon, tendon than aponeurosis, and aponeurosis than muscle. Arteries, as already seen, often escape in a remarkable manner, their astonishing elasticity enabling them to glide away from the flying projectile. Common integument, too, readily throws a partially spent ball out of the straight line. Deflection of every description, however, is much less frequent now than formerly, owing to the substitution of the conical for the round ball, the former readily penetrating everything, even when fired at a great distance, whereas the latter is easily spent, and arrested on coming in contact with the more resisting tissues.

A ball, upon meeting a sharp bone, as the crest of the tibia, is sometimes cut in two as smoothly and evenly as if it had been divided with a knife. Some years ago I attended a gentleman, who, in a street rencontre, was wounded with a pistol, the ball striking the clavicle, which cut it into two nearly equal portions, one bounding off, and escaping, the other lodging in the lower part of the neck, from which I removed it several months afterwards. Cases have occurred in which, as before stated, bullets have been split into a number of pieces, each perhaps making a separate orifice in the skin.

The old round ball, in passing through the bones, often made a hole much larger than itself, especially when its force happened to be partially spent. Indeed, cases were occasionally observed in which the opening was so capacious as to admit, not only the ball, but also the barrel of the weapon from which it was discharged. The opening made by the conical ball is, on the contrary, comparatively much smaller; but, although this is the fact, the mischief which it inflicts is proportionably much greater, owing to the manner in which it breaks and comminutes the osseous tissue, the loose splinters themselves thus often becoming a source of severe injury to the soft parts.

Grave injury is sometimes inflicted upon a bone, even without the occurrence of fracture, simply from the violence of the shock which it experiences. The bullet strikes its surface with great force, bruising the periosteum, and causing dreadful concussion of the osseous tissue, but the force with which it is impelled is not sufficient to enable it to effect penetration. Erysipelatous inflammation is set up, followed by exhausting suppuration, and, perhaps, sloughing and death.

Windage of Balls.—The older writers on military surgery had much to say respecting the windage of balls. It is well known that the most horrible injuries may be inflicted upon the body by cannon shot, completely pulpifying the muscles, lacerating the vessels and nerves, laying open large joints, and literally mashing the bones, and yet, perhaps, hardly bruise the skin, much less produce any serious wound. To account for these phenomena, various theories were invented, and it is not a little strange that the correct explanation of them should have been reserved for comparatively modern times. Even as late as the early part of the present century, several writers puzzled their minds to solve the much vexed question by a series of ingenious reasoning and argumentation worthy of a better cause. Thus we find that one gentleman has endeavored to account for the accident by supposing that the ball, as it passes by the body, powerfully condenses the atmosphere, thereby creating a vacuum, which is instantly succeeded by the forcible expansion of the part and its consequent laceration. The explanation was intended to apply more particularly to injuries of this kind as they occur in the hollow viscera, as the stomach and bowels. Another ingenious speculator has imagined that the effect is due to the action of the electric current generated by the rapid movement of the missile through the air. Finally, Mr. Spence, an English naval surgeon, informs us that the cause, at least on shipboard, where such accidents are not infrequent, is the violent contact of the wadding and other substances, as pieces of canvas and rope-yarn, which are so liable to be carried along with the ball. We may admire the ingenuity which prompted these views, but their fallacy is too apparent to admit of deception. The true cause of these injuries is the manner in which the projectile strikes the surface. It has already been seen that a ball in rapid motion will, on reaching the body, pass through it in a straight line; or that, instead of this, it will, if it be large, as in the case of a cannon ball, carry away the part completely. But it is very different when the missile is projected lazily, or when, in consequence of the great distance over which it has travelled, its force is measurably exhausted. Then the slightest resistance will tend to deflect it, or change its course; it no longer passes in a straight line, but rolls or turns upon its axis after the manner of a billiard ball, and hence if, while in this condition, it strikes the body, it may inflict the most frightful injury both upon the muscles and bones, and yet not perhaps leave a trace of its effects upon the skin, the elasticity of which enables it to slide out of harm's way, while the other and deeper structures, which possess this property in a less degree or not at all, readily yield to its influence, and are severely injured in consequence.

That the older notions upon this subject are of a purely hypothetical character is shown by the fact that, during naval and military engagements, soldiers often have pieces of their dress, accoutrements, and even of their persons carried away by balls in rapid motion, without sustaining any serious injury in their bones and muscles. The faculty possessed by the integuments of gliding out of the way of mischief is admirably exemplified in railroad accidents, which strongly resemble those inflicted by partially spent cannon balls, and in which they frequently escape in the most astonishing manner, while the deeper parts, soft as well as hard, are frightfully torn and pulpified. These gunshot lesions are much less frequent now than formerly, in consequence of the general introduction of the conical ball, which does its work more neatly and effectually, as well as at a much greater distance, than the old round ball, which, however, is still occasionally used.

The distribution of wounds during a battle will necessarily vary with circumstances. In an engagement on the open field, the chances are that nearly all parts will suffer alike. In nearly four hundred cases of gunshot injury which I saw after the battle at Bull Run on the 21st of July, almost all the wounds were situated in the extremities, and in nearly equal proportion in the upper and lower. A few only had been struck on the head, chest, back, and abdomen. This cannot, however, be taken as a fair criterion of the result of the engagement, since those that were most severely wounded fell into the hands of the enemy. According to Hennen, of the wounds received in battle, ten will be in the upper extremity, seven in the lower extremity, seven in the head, four in the neck and chest, and two in the abdomen. Scrive, from his observations in the Crimean war, estimates that, in the open field, one-tenth of the wounds will be in the head, one-twentieth in the chest, and one-fortieth in the abdomen. Men, fired at behind breastworks, are most liable to suffer in the head, neck, chest, shoulders, and arms, the lower parts being protected by the defences.

Symptoms.—The symptoms of gunshot wounds necessarily resolve themselves into local and general, or into such as are peculiar to the part and system; and, it need hardly be added, vary greatly in their character, according to the extent of the lesion, the importance of the tissues involved, and the idiosyncrasy and other circumstances of the individual.

The *pain* consequent upon a wound of this kind is often quite insignificant, the person, although perhaps severely hurt, not being conscious of having received any injury until some minutes after it has been inflicted. In general, it is of a dead, heavy character, altogether different from that which attends an incised or punctured wound; it is only when a large nerve has been partially cut across that it is apt to be at all severe, and then it is usually very sharp, pricking, or burning. In this case, too, there will also be more or less numbness in the part below the wound, and sometimes, as when the principal nerve has been entirely severed, complete paralysis. Thus in gunshot wounds of the thigh, involving the division of the sciatic nerve, there is always loss of motion, and often, also, of sensation of the knee, leg, and foot, which feel as if they were cold and dead. The suffering is generally great when a bone is broken, a large joint penetrated, or a visceral cavity laid open, and the shock is then also much more severe and protracted. The pain, however slight at the moment of the injury, is sure to be greatly aggravated upon the supervention of inflammation, so that the patient frequently requires large doses of anodynes for its suppression.

The *hemorrhage* in gunshot wounds is generally not at all in proportion to the severity of the injury, owing, as is commonly supposed, to the contused nature of the lesion. The structures immediately around the track of the ball are usually so much condensed that, unless the divided vessels are large, or numerous, the bleeding will, in the majority of instances, be so slight as to excite little, if any, alarm for the patient's safety. Very frequently, indeed, it amounts to the merest oozing, which soon ceases spontaneously, or under the application of cold water. If a large artery, however, happens to be laid open, the hemorrhage will not only be copious, but may be so great as to prove speedily fatal, perhaps in a few minutes at farthest, and, consequently, long before the surgeon will be able to interpose his skill for the preservation of life. Such an event will be more likely to occur if, as often happens in this class of injuries, the vessel is only partially divided, so as to prevent its retraction; here the blood will flow most freely, and, although it may be temporarily arrested by syncope, the clot will be washed away the moment reaction takes place, and thus the case will go on, the fainting recurring until the patient has bled to death. If, on the other hand, the artery is completely divided, there may hardly be any hemorrhage whatever until the occurrence of reaction, or, perhaps, not even until the separation of the sloughs.

The ball often passes directly in the course of a large artery, perhaps the principal artery of a limb, and yet the vessel may completely escape injury, or, at most, be merely grazed by the missile. The reason of this is the resilient power of the vessel, which enables it to jump, as it were, out of the way of the projectile. Such an artery, however, will be particularly obnoxious to gangrene, and therefore to secondary hemorrhage during the separation of the sloughs.

The hemorrhage is generally external, the blood issuing at both orifices of the wound. The reverse, however, may be the case, especially if the injured parts have been thrown out of their relative position, or if, as sometimes happens, there has been extensive separation of the muscles; in such an event a large quantity of blood may be effused among the deep-seated structures, with hardly any outward bleeding. In wounds of the chest, abdomen, and pelvis, the hemorrhage is usually internal, and therefore the more dangerous, because concealed.

Gunshot wounds are, for the reasons already mentioned, extremely prone to *secondary hemorrhage*. A large artery may have been merely grazed, and, inflaming, a slough may form, which, separating, may give rise to severe, if not fatal bleeding in the space of a few minutes. Or an artery, of considerable size, may have been completely severed, but its ends, as well as the surrounding parts, having been violently contused, a clot is instantly formed, which thus affords a temporary barrier to the escape of blood; by and by, however, reaction takes place, and then perhaps the artery is reopened, its contents now gushing out in a full stream; or the event may not take place for some days, perhaps not until after the establishment of suppuration or the occurrence of gangrene and sloughing. Sometimes the injured vessel is completely blocked up by the ball or other foreign substance, upon the removal of which copious hemorrhage ensues.

Secondary hemorrhage, the result of sloughing, usually occurs from the tenth to the fifteenth day; much, however, will depend, in this respect, upon the size of the ball and the amount of injury sustained by the soft parts around the wound, as well as by the vessel itself. In some instances it does not appear before the twentieth, twenty-fifth, or thirtieth day; and, on the other hand, it occasionally occurs as early as the fifth, sixth, or seventh day. However this may be, the patient should be most sedulously watched until he has safely passed the critical period.

The *constitutional symptoms* of the lesion are subject to much diversity. The shock is sometimes severe in a degree altogether disproportionate to the violence of the injury; the stoutest and most courageous individual will often swoon away from the most insignificant wound, and, on the other hand, a man may have his limb completely shattered, and yet not evince any serious alarm; his mind is perfectly calm and collected, and he is perhaps able to give the word of command or cheer on his comrades up to the very moment of his dissolution. Temperament and idiosyncrasy have much to do in the production of these phenomena, and should have due weight in regard to our prognosis. It is said that veterans upon the field of battle generally, other things being equal, suffer much less apprehension and alarm from their injuries than new and inexperienced troops.

The subjoined case affords a good example of the manner in which shock occasionally causes death in gunshot wounds in civil life:—An army officer in 1851 fell in a duel near Louisville, the ball, which was very large, round, and fired from a rifle at a distance of forty yards, entering the left thigh a little above its upper third, lacerating the soft parts in the most horrible manner, laying open the femoral vein, and crushing the bone into numberless fragments. The missile then passed into the right thigh, where it lodged, producing, however, but little mischief. Although hardly a pint of blood was lost, yet the system never rallied; the face continued deadly pale, the extremities cold, and the pulse small and feeble, notwithstanding the free use of brandy, up to the moment of the patient's death, which happened in two hours after the rencontre.

Prognosis.—The prognosis of gunshot wounds varies with so many circumstances as to admit of being pointed out only in a very general manner. Some of the milder cases of this class of injuries often recover promptly, without a solitary untoward symptom, the parts occasionally uniting, as I have myself seen in several instances, by the first intention. In other cases, on the contrary, apparently of a mild character, severe nervous symptoms may arise, or the wound may take on erysipelas, or a bad form of inflammation, and the patient lose his life. Two years ago I attended, in this city, a young man who had been shot with a pistol, the ball, which was small, having entered the outer and back part of the arm, just above its middle, grazing the humerus, and lodging immediately under the integuments, from which I removed it an hour afterwards. The ordinary treatment was employed; but in thirty-six hours violent erysipelas set in, and death occurred in less than eight days from the time of the injury. On the other hand, seemingly the most desperate cases will sometimes recover. Much will of course depend, in every instance, upon the size and situation of the wound, the presence or absence of complications, the state of the patient's constitution, the condition of the atmosphere, and the nature of the treatment.

Some gunshot wounds must necessarily be fatal, either instantaneously, as when they involve one of the more important organs, or a large vessel, or, more or less remotely, as a consequence of the resulting inflammation, gangrene, or profuse and exhausting discharge. The danger to limb, if not to life, will be great when a large joint has been laid open, the main artery, vein, or nerve severed, the bone crushed, or the integument extensively stripped off; or when all, or nearly all, of these parts suffer together. Gunshot wounds of the lower extremity are, other things being equal, more dangerous than those of the upper, sharing, in this respect, the same fate as ordinary lacerated and contused wounds.

The presence or absence of complications will necessarily exert no little influence upon the issue of the case. Thus, a person, even if but slightly wounded, will often suffer most severely, and perhaps even die of the effects of his injury, if he was laboring at the time he was hurt under any serious disease of some internal organ, as the liver, lung, or bowel. The habits of the patient must also be taken into the account; if he is intemperate, his chances of recovery will be diminished, and so also if his constitution has been enervated by long residence in a warm, unhealthy climate. Wounds inflicted in battle are generally more fatal than those received in civil life, especially if they are treated in crowded, ill-ventilated hospitals. Death then often occurs from sheer neglect, or the want of good nursing and suitable surgical treatment.

The causes of death in gunshot wounds are, first, shock and hemorrhage; secondly, tetanus; thirdly, pyemia and erysipelas; fourthly, gangrene; and fifthly, profuse suppuration and hectic irritation.

Remote Effects.—The remote effects of gunshot wounds are often very troublesome, entailing much suffering, and being occasionally followed by loss of life at the distance of many years. In a case of gunshot wound of the chest, related by Dr. M. H. Houston, of Wheeling, Virginia, a thick linen patch, with which the ball had been enveloped, remained in the left lung for twenty years, when the patient died in a state of extreme marasmus, his general health never having been good since the occurrence of the accident. Sometimes a bullet lodges in the head of a bone, where, although it may for a while be comparatively harmless, it ultimately causes necrosis, with inflammation and discharge in the soft parts, thus necessitating the removal of both substances, if not of the limb itself. It is related of Marshal Moncey that he died from the effects of a gunshot wound forty years after its receipt.

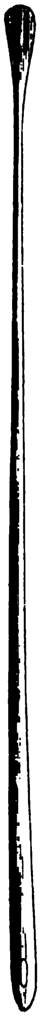
On the other hand, however, a ball may occasionally remain in the body for a long time—perhaps in an organ even of vital importance—without inducing any particular mischief. Thus, in a case recently reported by Dr. Henry Wurtz, of New York, an ounce bullet was found, on dissection, in the middle lobe of the right lung of an old soldier, forty-five years after its introduction at the siege of Badajoz. It was inclosed in a distinct cyst, an inch below the surface of the organ, having entered between the fourth and fifth ribs, as was proved by the existence there of an old cicatrice.

Treatment.—In the treatment of gunshot wounds five distinct indications are presented: 1st. To revive the patient, or promote reaction; 2dly. To arrest hemorrhage; 3dly. To extract the ball and any other foreign matter that may have entered along with it; 4thly. To remove any detached or loose pieces of bone; and 5thly. To circumscribe the resulting inflammation.

1st. The first indication is to relieve *shock*, and this is to be fulfilled by the employment of the ordinary restoratives. If the patient be faint, he must be placed at once in the recumbent posture, with his head as low as the rest of the body; cold water must be dashed upon the face, the fan be freely used, and smelling bottles held near the nose. If the symptoms are urgent, sinapisms are applied to the chest, spine, and extremities, a stimulating injection is thrown into the bowel, and, if the power of deglutition is not gone, brandy or wine and ammonia are given by the mouth. If there be internal hemorrhage, however, care is taken to bring up the pulse slowly and gently, allowing time for the formation of coagula, and guarding against the occurrence of violent inflammation. A kind look, or a soothing expression will often do more to revive the patient and encourage recovery than anything else.

2dly. If the *hemorrhage* be capillary, or caused by the division of very small vessels, it will probably cease of its own accord, or simply by exposure of the part to the cold air, or under the application of cold water, pounded ice, or some astringent lotion. If it be venous, compression will probably suffice; but if it proceed from a large artery, such as the radial or tibial, nothing short of the ligature will do, and no time should be lost in its application. The case is very simple when the vessel is superficial, and the wound capacious; but under opposite circumstances the duty of the surgeon is often exceedingly embarrassing. Here it becomes necessary either to dilate the wound, so as to expose the artery and tie it at both ends, which is by far the best plan; or, where this is impracticable on account of the depth of the vessel, its proximity to important structures, or the great swelling and infiltration of the parts, as may happen when some time has elapsed since the receipt of the injury, to cut down upon the main trunk of the vessel, and to secure it as in the Hunterian operation for aneurism. The latter procedure, however, will rarely succeed, inasmuch as the bleeding is extremely liable to be kept up by the recurrent circulation; hence it is always best, if practicable, to cut down at once upon the injured artery, and to apply a ligature to each extremity, which cannot fail to put an effectual stop to the flow of blood. The more promptly the operation is performed the better; if the surgeon wait till inflammation has supervened he will experience great difficulty, not only in exposing the artery, but also in inducing the ligature to maintain its hold upon its softened and partially disorganized tissues. When the hemorrhage has been very profuse, but has gradually or suddenly stopped, it will hardly be safe to intrust the case to the efforts of nature, because, when reaction occurs, the vessel will almost be sure to be reopened, and thus the bleeding may progress until the system is completely exhausted; but if the surgeon has done his duty, the parts will be placed in the best possible condition for speedy recovery. It is a good rule, in such cases, to do whatever may be necessary without the slightest temporizing.

Fig. 72.



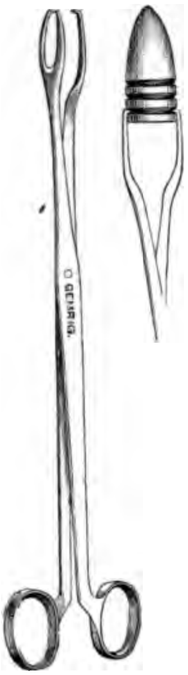
3dly. The third indication is the *extraction* of the ball; but to do this it is necessary, in the first place, to ascertain where it is; to grope about in the wound without any definite ideas as to its precise location, would only be to inflict additional pain and injury. In order to conduct the examination with the greatest advantage, the part should be put as nearly as possible in the position in which it was at the time of the accident. This is the more necessary, because, as was before stated, the missile often pursues a very different route from what might be supposed from merely looking at the orifice of entrance or exit; the slightest resistance may change its direction, and compel it to lodge at a situation far beyond what it would have sought had it been permitted to pass in a straight line. Hence attention to the position of the part becomes, in all cases, a matter of paramount importance.

Care must be taken in searching for a ball not to mistake for it an osseous prominence. Stromeyer refers to two cases in which he saw this blunder committed; in one the surgeon cut down upon the head of the fibula, and in the other upon a metatarsal bone. The assertion of a patient that the ball has dropped out is seldom reliable, unless the missile is found in his pocket.

The best *probe* for conducting the examination is the finger, provided it is sufficiently long and slender; it possesses the same value, in such cases, as direct auscultation possesses in the exploration of the chest, or the finger in the examination of the uterus and rectum, and should therefore always be used when practicable. If the digit be inadequate, recourse is had to a stout probe, fig. 72 or fig. 73, at least from ten to twelve inches in length, as thick as a medium-shaped, with two curved prongs, separated in front by a narrow interval, and terminating each in a point. The other blade has only one prong, also curved, but central, and terminating in a point, which, when the forceps are shut, is received in the interval here alluded to, thus rendering its extremity perfectly blunt. The instrument, represented in fig. 76, answers for the round as well as the conical ball, and possesses the great advantage of facility of application with firmness of grasp.

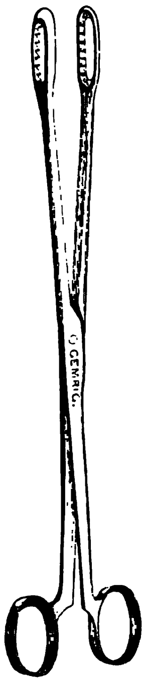
The forceps delineated in fig. 77 were made last summer, at my suggestion, by Mr. Gemrig. They are about nine inches and a half in length, light, slender, and fenestrated at the extremity, which is scooped out in such a manner as to embrace the ball with great facility, while its inner surface, roughened like that of a stirrup, maintains its hold with extraordinary firmness.

Fig. 76.



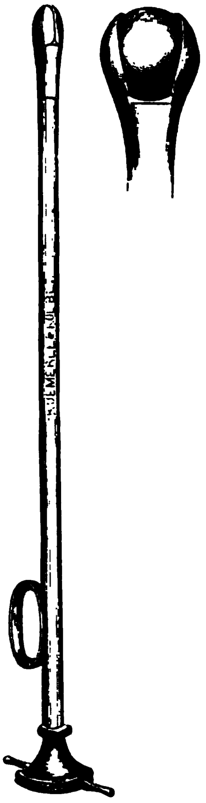
Gemrig's forceps.

Fig. 77.



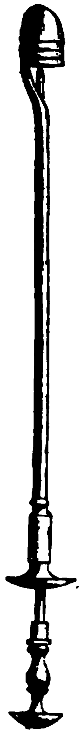
Author's forceps.

Fig. 78.



Kolbé's extractor.

Fig. 79.



European extractor.

When the wound is unusually large, and the ball not deeply seated, the extraction may sometimes be effected with a small lithotomy scoop, the common dressing or polypous forceps, or an instrument like that sketched in fig. 78, made for me by Mr. Kolbé, of this city. It consists of a silver tube, inclosing a steel stylet, terminating in two blades, cup-shaped on the inside, and movable by a hinge. The extremity of the instrument is seen grasping the ball. Fig. 79 represents a similar instrument used by the British and French surgeons.

The gimlet-like instrument, so much extolled by the older surgeons, is now rarely used, although it might still occasionally be employed with advantage when the extraneous substance is lodged in a bone thickly covered by muscles. The trephine, however, is generally preferred under this and other similar circumstances.

A ball, after having traversed the thickness of a limb, or of the body, occasionally lodges immediately beneath, or among the superficial muscles, where its presence is readily detected by the probe or finger. In such a case the best plan is to remove it by a *counter-opening*, that is, by cutting down upon it at the nearest point; a procedure which often saves an immense amount of pain and trouble.

When the ball cannot be found without much probing and the risk of inflicting serious additional mischief, reason and experience alike suggest the propriety of letting it remain, in the hope that it may either become encysted, or that it will be detached and washed away by the discharges. In general, however, every justifiable effort should be made to remove it, on the ground that, if left behind, it will be almost sure to excite violent inflammation, followed by profuse suppuration and extensive separation of the tissues. Such an event will be the more likely to happen if the ball has become rough, jagged, or flattened by contact with a bone; for then it never can be encysted, but must necessarily keep up irritation as long as it remains.

The great importance of not permitting balls to remain unextracted has been placed in a forcible light by the observations of Mons. Hutin, chief surgeon of the Hôtel des Invalides of Paris. Of 4,000 soldiers examined by this distinguished practitioner, within a space of five years, only 12 presented themselves who had experienced no inconvenience from the retention of foreign bodies, while the remainder, 200 in number, had all suffered more or less severely until they had been relieved by operation.

Another reason for the early extraction of these missiles is that persons soon after the receipt of their injuries will, in general, submit much more readily to the necessary operation than they will after they have partially recovered from their effects; their dread usually increasing in proportion as they get well, and beyond the reach of immediate danger.

When a ball has entered a movable joint, it should always be promptly extracted if it lie loose within its cavity; if, on the other hand, it has lodged in the adjoining bone, it should be allowed to remain, in the hope that it may soon be covered over with plastic matter, and thus become comparatively harmless. The only exception to this rule is where the ball projects into the cavity of the articulation, in which case it should be removed at all hazard, since its retention would inevitably lead to violent, if not fatal, inflammation, and utter uselessness of the part.

No sensible surgeon ever thinks of searching for a ball in any of the great cavities of the body; such a procedure would be sure to increase the dangers of the accident, and cannot, therefore, be too pointedly condemned.

If it be necessary to the welfare of the part and system to remove a ball, which is a comparatively innocuous substance, how much more important is it to extract the various *foreign bodies* which so often enter along with it, and the presence of which is an incessant source of irritation and annoyance, however protracted it may be. The rule here is imperative, and applies to the smallest, as well as to the largest substance; to the little piece of wadding and the stoutest splinter, the linen shred and the brass button; in short, to all extraneous matter whatever. Wherever it may be, it must be sought for, and, if possible, extracted without delay. There is no chance here of the formation of a cyst, as sometimes happens with a ball; nature admits of no such liberty. In naval and military engagements large pieces of wood, metal, and other substances are liable to be impelled into the body, in which they are often buried at a great depth, or lodged among the muscles, which sometimes close over them in a sort of valve-like manner, rendering it extremely difficult not merely to extract but even to find them. Much may be done in such cases by the gentle use of the finger and probe, aided by counter-pressure.

4thly. Any detached *splinters* of bone, or pieces of bone so much loosened as to render it improbable that, if left behind, they will become reunited, should be removed as early as possible after the occurrence of the accident, experience having shown that their retention is always productive of extensive and protracted suppuration, if not of worse results. By the timely extraction of such bodies immense suffering may be prevented, and ultimate recovery vastly expedited. It is surprising that surgeons should ever hesitate in such a case; and yet the instances are not uncommon where the most culpable neglect is observed. A remarkable example of the kind fell under my notice in 1847, in the person of Lieut. George Adams, of the United States Marine Corps, who was desperately wounded in the right thigh by a large musket ball during our war with Mexico, at the battle of the National Bridge, between Vera Cruz and Jalapa. The soft parts were extensively injured and the bone was shattered into numerous fragments, not less than twenty-four of which, some of them upwards of an inch and a half in length, I removed nine months afterwards, from the enormous callus that had formed around the seat of the fracture; most of them were completely imprisoned in the osseous matter, and it was therefore found quite difficult to extract them. The incisions healed kindly, except at one point, which refused to close, and from which a small fragment of bone was subsequently removed by the late Professor Warren, of Boston.

When *powder* is imbedded in the skin, the first thing to be done is to pick out, with a cataract needle, or delicate bistoury, every particle of it, regardless of pain. If this be neglected the powder will speedily excite inflammation, besides causing disagreeable and permanent disfigurement by the bluish spots which it leaves. The operation is tedious, and is always attended with severe suffering. The resulting inflammation is to be combated in the usual manner; cold water, or cold saturnine lotions, being generally the best local remedies.

5thly. The fifth and last indication is to circumscribe and moderate the resulting *inflammation*. To accomplish this, attention to various points is necessary. In the first place, the parts must be properly dressed. Works on surgery generally direct that the orifices of the wound shall be lightly covered with lint and adhesive plaster. Is such a procedure rational? It certainly is not, for its direct effect must inevitably be to prevent discharge, of which there must always be more or less in every such case, and consequently to aggravate the local mischief. A much better plan is to allow the orifices to remain open, while we attempt, by means of a light compress and bandage, to close the sides, with a view of facilitating their union by adhesive action. The roller should be carried up from the distal part of the limb to some distance beyond the wound, care being taken to perforate it opposite its orifices, in order to admit of free drainage. In this manner nature may often be immensely assisted in the cure; the inflammation will generally be moderate, infiltration of fluids will be obviated, and the patient will frequently recover in a surprisingly short period, and with but little suffering. The bandage, however, must be used with great caution, for there is danger, especially if there be much swelling, of its producing injurious compression, and thus becoming a source of gangrene. My experience in the treatment of gunshot wounds is necessarily limited, but it is sufficient to justify me in asserting that adhesive plaster should, as a general rule, be dispensed with; it is certainly not easy to perceive how it is possible for it to do any good.

to provoke tetanus. In all cases due allowance must be made, in our treatment, for the drainage which is likely to attend such injuries. Hence much judgment is often required to steer clear of difficulty and danger. Bleeding by the lancet is hardly to be thought of under any circumstances; in young and plethoric subjects, however, blood may occasionally be taken advantageously by leeches. In ordinary cases, the diet should be plain and simple, rigid abstinence not being required, excepting when there is unusual fulness of habit. If decided exhaustion be present, whether from shock, loss of blood, or inflammatory disturbance, prompt recourse must be had to milk punch, quinine, and nutritious food.

When a tendency to erysipelas or pyemia arises, the patient, in addition to the means already indicated, should be promptly put under the influence of iron and strychnia, or of these two articles with quinine and brandy; and, if large numbers of wounded are crowded together, no time should be lost in effecting their sequestration.

QUESTION OF AMPUTATION IN WOUNDS.

The most horrible wounds are generally those which are inflicted by machinery in rapid motion, the passage of a railway car or the wheel of a heavy wagon, and the explosion of fire-arms, violently lacerating and contusing the soft parts, extensively crushing the bones, and perhaps opening one or more of the larger joints. In many cases, the character and extent of the mischief are apparent at first sight; in others, as when it is principally subcutaneous, it becomes so only after a most patient and thorough examination. The latter class of injuries is particularly to be dreaded, as it is often impossible, even with the greatest care, to determine the extent of the lesion. When the examination necessary to ascertain the condition of the parts is likely to be painful or protracted, commiseration for the sufferer always dictates the propriety of administering chloroform, although the effect of the anæsthesia will rarely be required to be carried to the extent of complete unconsciousness, a few full and prolonged whiffs being generally sufficient to effect the desired tolerance.

In attempting to determine the question as to whether an attempt should be made to cut off or save a limb, not a little stress should be laid upon the age, habits, and previous health of the patient, the manner in which the injury was inflicted, and the number, variety, and importance of the structures involved.

Young adults bear severe accidents much better, other things being equal, than the two extremes of life, childhood and decrepitude, in both of which, but especially the latter, the power of reaction is generally very feeble, and the effect of shock and hemorrhage felt for a long time. Nevertheless, there is not a practitioner of any experience that has not occasionally witnessed striking exceptions even under these circumstances. A temperate man usually bears up under a severe wound much better than a dissipated one, and the resident of the country than the inhabitant of the crowded city; a person in ill health at the time of the accident will be likely to suffer more than one in an opposite condition. The worst class of accidents in civil practice are those inflicted by railway cars, steamboats, and steam factories, and these are often of such a nature as to require the prompt removal of the mangled and mutilated parts.

But of all the circumstances influencing the recovery of the patient, and the ability of the surgeon to save the mutilated parts, the most important, by far, is the extent of the injury, or the number and nature of the tissues involved.

tance above the apparent seat of the injury. If this precaution be neglected, mortification will be liable to seize upon the stump, owing to the fact that, in such cases, the injury, both of the soft and hard parts, usually extends much further than the naked eye can discover.

Should amputation be performed when a limb, the subject of a severe wound, laceration, or contusion, has been suddenly seized with mortification, manifesting a rapidly spreading tendency, extending, perhaps in a few hours, up as far as the middle of the leg, or even as high as the knee? In general, such cases are desperate; no local or internal remedies can arrest the morbid action; the system has sustained a profound shock, and the affected parts perish, not by inches, but literally by feet. I have repeatedly seen this variety of gangrene extend from the toes, instep, or ankle as far as the hip-joint in less than thirty-six hours, and that, too, in cases where there was but little visible injury, the mischief being evidently deep-seated, involving muscle, nerve, vessel, and bone. If amputation be not performed, the disease, whose march is indicated by a bluish or livid, crepitating, and tender streak along the limb, will be sure to terminate fatally in a few days, and the operation should therefore, in my judgment, be resorted to at the earliest possible moment, the surgeon not foolishly waiting for a line of demarcation, which cannot take place, since neither part nor system has the power of arresting the morbid action. The event, it is true, will generally be unfavorable, but as it is the only chance the patient has, he should, slender though it be, certainly have the benefit of it. In the few cases in which I have amputated under these unpropitious circumstances, the result in all has been fatal.

Lacerated, contused, and gunshot wounds are often of so frightful a nature as to render it perfectly certain, even at a glance, that the limb will be obliged to be sacrificed in order that a better chance may be afforded for preserving the patient's life. At other times, the injury, although severe, may yet, apparently, not be so desperate as to preclude, in the opinion of the practitioner, the possibility of saving the parts, or, at all events, the propriety of making an attempt to that effect. The cases which may reasonably require and those which may not require interference with the knife are not always so clearly and distinctly defined as not to give rise, in very many instances, to the most serious and unpleasant apprehension, lest we should be guilty, on the one hand, of the sin of commission, and, on the other, of that of omission; or, in other, and more comprehensive terms, that, while the surgeon endeavors to avoid Scylla, he may not unwittingly run into Charybdis, mutilating a limb that might have been saved, and endangering life by the retention of one that should have been promptly amputated. It is not every man, however large his skill and experience, that is always able to satisfy himself, even after the most profound deliberation, what line of conduct should be pursued in these trying circumstances; hence the safest plan for him generally is to procure the best counsel that the emergencies of the case may admit of. But in doing this, he must be careful to guard against procrastination; the case must be met promptly and courageously; delay even of a few hours may be fatal, or, at all events, place limb and life in imminent jeopardy. Above all, let proper caution be used if the patient is obliged to be transported to some hospital, or to a distant home, that he may not be subjected to unnecessary pain, exposed to loss of blood, or carried in a position incompatible with his exhausted condition. Vast injury is often done in this way, by ignorant persons having charge of the case, and occasionally even by practitioners whose education and common sense should be a sufficient guarantee against such conduct. The transportation of a patient to a distance of perhaps a hundred or a hundred and fifty miles upon a railway car, after he has been desperately wounded, in the hope, it may be, of obtaining better aid, cannot be too severely reprehended, as involving not only the loss of precious time, but often also the infliction of additional injury upon a part and system already overwhelmed by shock and hemorrhage.

Resection in gunshot and other injuries involving the articulations is, as will be more fully explained elsewhere, applicable chiefly to the shoulder and elbow-joints, in cases unattended with serious lesion of the soft parts. In the former, a portion of the humerus, embracing, if necessary, from three to five inches in length, together with a part or even the whole of the glenoid cavity of the scapula, may be safely and expeditiously removed under such circumstances, and yet the patient have an excellent use of his arm. Experience shows that primary excision of the other joints, excepting, of course, the smaller ones, as those of the hand and foot, is generally very unfavorable.

Further observations upon this subject will appear in the chapter on amputation, and in those on fractures, dislocations, and resections.

SECONDARY EFFECTS OF WOUNDS AND CONTUSIONS.

Every practitioner occasionally meets with cases of wounds and bruises in which the patient, happily escaping from the primary effects of the injury, suffers severely from what may be termed the secondary effects, coming on several weeks or months afterwards. These lesions have not received sufficient attention from systematic writers. It has fallen to my lot to see quite a number of such cases, and I select the following from my note-book in illustration of the subject:—

A farmer, aged thirty, in August, 1851, got his left foot twisted and bruised by a fall from his horse. The accident was instantly followed by severe pain, and next day by excessive swelling, which, however, gradually subsided under the usual antiphlogistic remedies. In the course of a few weeks the man was able to exercise on crutches, but the foot was now observed to be very sore and tender, cold, clammy, withered and benumbed, and to be completely destitute of power. There was also frequent twitching of the three small toes, particularly at night, so as to interfere with sleep. These symptoms were aggravated in damp, cold states of the atmosphere, when there were also occasionally neuralgic pains in the part. The general health likewise materially suffered, the appetite being bad, the bowels irregular, and the mind much dejected. When I saw the patient, nearly a year after the accident, he had been subjected to various plans of treatment, with hardly even any temporary relief. I placed him upon tonics and alterants, and ordered the hot and cold douche, with frictions with veratria liniment and the use of the bandage; but many months elapsed before he experienced much benefit from the treatment, and I believe he has never entirely recovered the use of his foot and ankle.

A man, aged 25, cut himself, in October, 1852, with an axe on the instep of the left foot, directly over the internal cuneiform bone. The weapon penetrated the bone, and evidently severed the extensor tendon of the great toe, as the toe could no longer be moved by the effort of the will. The wound healed completely in a few days, but in a short time afterwards the parts became tender and remained so for several months. Meanwhile, the foot and leg grew sensibly thinner, and were habitually cold and clammy; a state of things which has now continued for several years. Whenever exercise is taken, the parts swell, and become tender. The muscles of the whole limb are flabby and wasted. The general health is much disordered; the man has lost thirty pounds of flesh, and has been unable to attend to any business since the accident. His tongue is habitually coated, he sleeps badly at night, and he is subject to frequent fits of despondency.

A man, aged 35, consulted me in March, 1854, on account of an accident similar to the above. He was a bricklayer by occupation, and previously was always in good health up to October, when he cut himself with a hatchet in the left instep, immediately over the internal cuneiform bone, as nearly as possible in the same situation as in the preceding case. The wound healed rapidly, but the man soon began to suffer with exquisite pain and tenderness in the parts, extending up the leg, and subject to severe exacerbation from damp states of the atmosphere, exposure to cold, and derangement of the digestive organs. The suffering was not regular in its recurrence, but it was generally worse at night, and often sadly interrupted his sleep. The limb was cold and clammy, as well as much emaciated, and the parts immediately around the scar were hard, as if from the presence of organized lymph. The general health was much impaired, the tongue was coated, and the sleep was usually much interrupted by spasm of the limb. A prominent symptom in the case was great soreness in the hollow of the foot, in front of the heel. When the man attempted to walk, the foot became very tender, and began immediately to swell. Both in this and in the preceding case the patient was obliged to use crutches.

A lady, aged 27, the wife of a medical gentleman, in February, 1852, punctured the forepart of her right wrist, towards the ulnar margin of the forearm, with a small slender sewing needle, which entered the skin directly over the ulnar artery, and passed, apparently, obliquely inwards and outwards towards the centre of the joint, without, however, penetrating it. The needle was immediately withdrawn, but not examined, and the patient, consequently, was uncertain whether a portion had broken off and remained behind. The accident was followed by the most excruciating pain, pervading the entire extremity from one end to the other, but being particularly severe at the seat of the injury and in the thumb and first two fingers. A violent rigor soon succeeded, and for ten days the patient suffered the most horrible tortures, being frequently threatened with tetanus, and constantly annoyed with spasmodic twitches of the muscles of the hand and arm. Considerable swelling arose soon after the receipt of the injury in the forearm, wrist, hand, thumb, and the fingers above named. About the end of the tenth day a small circumscribed abscess formed at the site of the puncture, which, upon being lanced, discharged about a drachm and a half of thick pus, much to the relief of the patient. In a week the matter had reaccumulated, and the part was again lanced, followed by the same relief as before. Subsequently the skin was scarified several times, the cuts bleeding profusely at each operation, but not yielding any pus.

During the following summer the patient experienced severe and constant pain, especially in the anterior part of the arm, between the elbow and the insertion of the deltoid muscle; it was always more violent in the evening, and was of a dead, heavy aching character; the limb was stiff and numb.

When I first saw the patient, in November, 1852, she informed me that her general health had been very bad for the last six years, that she was subject to dyspepsia, and that she was naturally of a nervous, excitable temperament. She had formerly suffered, at intervals, from rheumatism. For the last four months she had had a seton in the upper and fore part of the arm, on account of the severity of her pain, which, however, at this time, was much less than formerly. She thought she had derived much benefit from the seton. Her hand and thumb, together with the fore and middle fingers, swelled every evening, becoming stiff and sore, so that she could with difficulty flex or extend them. In the day the parts felt much more comfortable. The pain and soreness were always greatest at night. Pressure at the seat of the puncture gave rise to uneasiness rather than to pain, but was always followed soon after by so much distress as to prevent sleep during the succeeding night. The ring and little fingers were natural, free from swelling, and easily moved. The whole limb was cold and considerably wasted.

The probability is that, in this case, the needle pricked the ulnar nerve at the wrist, producing a condition of things, in her bad state of health, similar to that which occasionally results from the puncture of a nerve in bleeding at the arm.

Under the use of an alterative and tonic course of treatment, with strychnine and arsenious acid; the hot and cold douche, followed by friction with veratria ointment; a nutritious diet and exercise in the open air; the general health rapidly improved, and the local suffering finally disappeared, though the limb has never recovered its original powers.

Bad effects not unfrequently follow upon gunshot wounds; they present themselves in different forms and degrees, and often entail great suffering along with partial loss of function. Among the more common and annoying of these secondary effects are neuralgic pains and a sense of numbness in the parts, progressive atrophy of the muscles, contraction of the aponeuroses and tendons, and anchylosis of the joints.

In regard to the treatment of these secondary lesions, it is impossible to lay down any definite plan of action; every case must be managed according to the peculiarities of its symptoms. Much benefit may generally be expected from attention to the state of the general health, which is nearly always more or less seriously disordered. Neuralgic pains, altered sensibility, and atrophy usually require a course of tonics and arsenic, purgatives, the hot and cold douche, and dry frictions. Rigidity of the joints must be counteracted by passive motion and sorbefacients; contraction of the tendons and aponeuroses by the use of splints and the bandage.

MAGGOTS IN WOUNDS.

The development of maggots in wounds and compound fractures is a circumstance worthy of notice in a practical point of view. Such an occurrence is met with chiefly in hot weather, but I have also seen it in the autumn and early part of winter, in consequence of the artificial heat of the patient's apartment. In tropical climates the formation of maggots in wounds and ulcers is almost unavoidable, despite the best directed efforts to prevent it. The soldiers in Syria, under Larrey, and our troops during the war with Mexico, suffered greatly from this cause. Dr. Proctor informed me that wounds, however carefully cleansed one morning, were found, on the succeeding evening, to contain large numbers of these animals, and if the slightest neglect took place, they speedily collected in incredible quantities, and of prodigious size, their diameter equalling that of a small-goose quill, while their length ranged from three to nine lines. The soldiers had a great horror of them, and from the disposition which they evinced to burrow deep among the muscles, they were productive of no little pain and distress.

Fortunately the formation of maggots is not often seen in civil practice, where patients can enjoy all the conveniences and comforts of home; nor is it usual to meet with them in public institutions; still, the fact that such an occurrence is possible cannot be too firmly impressed upon the mind of the young and inexperienced practitioner.

The best preventive of this occurrence is cleanliness, with a frequent change of dressing, and burying the affected parts in light bran, so as to place them beyond the reach of flies, which, under almost any other mode of management, are sure to find their way to the wounded surface, the slightest crevice affording them access to the much coveted spot. Moisture and a high temperature are the causes which most rapidly conduce to the formation of maggots. The means that prove most destructive to them are spirits of turpentine, creasote, and alkaline solutions, particularly chlorinated soda. Dr. Atkinson, of the British army, has found no remedy so efficacious as calomel, sprinkled upon the wound, or blown into it from a quill.

Horrible suffering has been known to result from the development of maggots in the nose, from the accidental deposition of larvæ during a fit of intoxication. Dr. Bamford, who formerly practised in Texas, has communicated to me the particulars of the case of a man who perished from the effects of maggots formed in the nasal cavities and frontal sinuses, from which it was found impossible to dislodge them by any means that could be devised for the purpose. The patient suffered great agony, and died in raving delirium. It is easy to conceive how, in a hot climate, in consequence of the want of cleanliness, the larvæ of the fly might be deposited in an ear affected with profuse suppuration, or, from a similar cause, even in the vagina. Disgusting as such an occurrence is, it is by no means a matter of improbability.

SECT. VIII.—POISONED WOUNDS.

Under this head are included four distinct classes of wounds: first, those inflicted by venomous insects and snakes; secondly, those caused by the bite of rabid animals; thirdly, those produced by inoculation with the poison of glanders; and lastly, wounds received in the examination of dead bodies, constituting what are called dissection wounds.

1. WOUNDS INFLICTED BY POISONOUS INSECTS.

There are various genera of insects which naturally secrete a poison, which, when instilled into the living tissues, is capable of producing serious and even fatal consequences. Of these the most common, at least in this country, are the humble-bee, the honey-bee, the wasp, hornet, and yellow-jacket. The poison of these insects is contained in a small vesicle in the abdomen, and is under the control of a peculiar muscular apparatus by which it is injected into the puncture made by the barbed sting of these little creatures. It is highly acrid in its qualities, especially in the honey-bee, hornet, and yellow-jacket, transparent, and of a sweetish taste at first, but afterwards hot and disagreeable, being particularly active during the heat of summer. When roused to anger, these insects sting with great fury, producing a wound which is instantly followed by a sharp, pungent, itching pain, and in a few moments after by a circumscribed inflammatory swelling, pale, and elevated at the site of injury. In some persons, owing to idiosyncrasy and other causes, the symptoms are exceedingly severe and even alarming, the patient having dimness of sight, vertigo, nausea, palpitation, and a feeling of indescribable oppression, with a disposition to swoon. Instances have occurred in various parts of the country of persons having been stung to death by a single honey-bee; one such case, of which I have the particulars, occurred, many years ago, in Kentucky, in a man upwards of thirty years old. He was wounded on the face, and died in a few hours. I know a young man who always suffers from severe sickness of the stomach and great nervous depression when he is stung by a bee. Violent effects sometimes proceed from the sting of a bee, wasp, or yellow-jacket in the fauces, œsophagus, or stomach, when these insects are accidentally swallowed in cider and other drinks.

of the bite of the tarantula, so far as they have been studied, would seen be very similar to those produced by the sting of the common scorpi Hence similar treatment would probably suffice.

2. WOUNDS INFLICTED BY VENOMOUS SERPENTS.

The number of poisonous serpents in different parts of the world is considerable; but in this country there are, so far as is at present kno only three genera that are at all dangerous on account of their bite. Tl are the crotalus, trigonocephalus, and elaps. Of the crotalus, or rattlesn so called from the peculiar appendage to its tail, Professor Holbrook, in Herpetology of North America, has described not less than six specie which the banded, striped, and miliary are the most common; all are ven ous, and consequently capable of inflicting deadly wounds. These rep formerly abounded in almost every section of the United States, especi in the swampy and mountainous regions, but are now hardly ever met in our denser settlements.

All the different species of rattlesnakes are provided with two small s each of which contains a minute quantity of poison, and communicates means of a short excretory duct, with the canal in the fang on each sid the upper jaw. It is inclosed by a bony framework, situated external to proper jaw, and is under the control of appropriate muscles, the actio which aids materially in expelling its contents. The fangs, situated jus the verge of the mouth, are very long, sharp, and crooked, like the claw a cat, and are naturally retracted and concealed in a fold of integument; when the animal is irritated, are capable of being instantly raised, and da forwards with great force into the skin, followed by an emission of poi The snake, then, does not bite, but strikes, making a punctured wound.

The annexed illustration represents the head of the rattlesnake, and

Fig. 80.

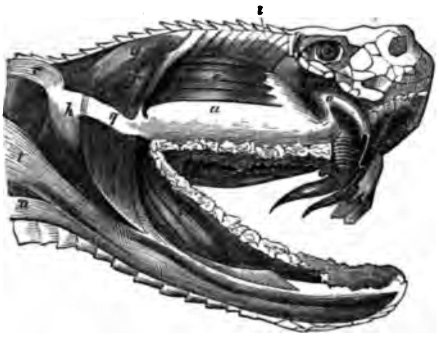


Fig. 81.

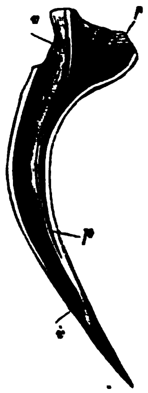


Fig. 80. Head of the rattlesnake. *a*, *a*. Poison gland, and its excretory duct; the latter cut op its extremity. *e*. Anterior temporal muscle. *f*. Posterior temporal muscle. *g*. Digastricus. *h*. Ext pterygoid. *i*. Middle temporal. *q*. Articulo-maxillary ligament, which joins the aponeurotic ca of the poison gland. *r*. The cervical angular muscle. *t*. Vertebro-mandibular muscle. *u*. Costo- dibular muscle.

Fig. 81. Poison fang, magnified. *p*, *p*. The pulp cavity of the tooth. *v*, *v*. The canal along the venom flows, truly on the outside of the tooth.

of the poison fangs, with the canal along which the venom flows when animal is in the act of inflicting its wound.

The poison of the rattlesnake is a thin, semi-transparent, albuminous fluid, of a yellowish color, with, occasionally, a tinge of green. According to Dr. S. Weir Mitchell, of this city, who has carefully studied its qualities, it is of a glutinous consistence, devoid of smell and taste, distinctly acid, of the specific gravity of 1044, and coagulable at a temperature of 140° to 160°. Its toxic activity is not materially, if at all, impaired by boiling and freezing, and alcohol, acids, alkalies, iodine, and chlorides, do not destroy its virulence. When dried, it retains its dreaded power for an indefinite period. Chemically examined, it is found to contain, besides coloring matter, and an undetermined substance, both soluble in alcohol, a trace of fatty matter, chlorides and phosphates, and two albuminoid principles, one coagulable at 212° F., the other, termed crotoline, not coagulable at this temperature, neutral in its action, freely soluble in water, and of a nitrogenous nature.

The quantity of venom contained in the poison-bag does not generally exceed a few drops; but it accumulates when the animal is inactive, and Dr. Mitchell had a snake which, on one occasion, ejected fifteen drops, its fang not having been used for several weeks. It is peculiarly acrid and deadly in hot weather and during the procreating season. In winter and early spring the reptile is in a torpid condition, and the poison is then diminished in quantity, and unusually thick, though not less virulent.

The *effect* of the wound of the rattlesnake varies with many circumstances, as the situation of the part, the acrid character of the poison, and the age of the patient. Experience has shown, as in the case of the bite of rabid animals, that most of those hurt in this way escape either entirely or suffer only in a very slight degree; the poison either failing to reach the tissues, or being too inert to make any decided impression upon the system. It is also known that adults are less liable to suffer than children, simply because they possess, as may be supposed, greater vigor of constitution, and consequently greater power of withstanding the influence of the venom. The deleterious effects of the poison seem to be much weakened, if not actually exhausted, by a rapid succession of bites. The experiments of Captain Hall, of Carolina, and of the late Professor Barton, of this city, place this subject in a very clear light. Of three dogs bitten in succession by a rattlesnake four feet long, the former gentleman found that the first died in less than fifteen seconds, the second in two hours, and the third in three hours. The subjects of Barton's experiments were chickens, and the results were almost identical with those of Hall. Of three fowls, bitten on three consecutive days, the first perished in a few hours, the second lived for some time, and the third easily recovered, although not without considerable suffering. Instances occasionally occur in the human subject of almost instant destruction from the bite of the rattlesnake; at other times the case proceeds more slowly, the patient not dying under several hours, or, perhaps, several weeks. Dr. Wainwright, of New York, lost his life in less than six hours from the time he was wounded. The animal, an uncommonly large one, had lain in a torpid state for some time, when, unexpectedly becoming warmed, he reared himself and struck his victim furiously on the last phalanx of the middle finger of the left hand. Although the wound was immediately sucked, and soon afterwards excised and cauterized, a ligature being also tied firmly round the wrist, the hand soon became enormously swollen, the tumefaction rapidly extending up the limb nearly as far as the axilla, and the surface, in the greater part of its extent, exhibiting a mottled bluish and greenish yellow hue. The pulse soon became very feeble, and beat one hundred and twenty in the minute; in four hours the patient was in a state of stupor, and died soon after in a completely comatose condition. Finally, in another series of cases, the patient, after having been near death's door for several weeks, eventually perishes, or recovers. When death occurs almost instantaneously, the probability is that the poison is injected directly into the blood, the fang having penetrated some tolerably large vessel. Under such circumstances, the fluid is found to be thin and black, and refuses to coagulate when exposed to the atmosphere.

When this poison has been freely instilled into a wound, the *symptoms* will always be proportionably severe. The moment the inoculation has taken place, excessive pain is experienced in the part, rapidly followed by swelling, which soon diffuses itself extensively over the surrounding surface, and is attended with a livid mottled appearance, dependent upon extravasation of blood in the subcutaneous cellular tissue. If the wound, for instance, occupies a finger, the tumefaction speedily extends up the limb, as far as the shoulder, and, perhaps, over a large portion of the corresponding side of the trunk, a feeling of numbness, weight, and coldness attending the other symptoms.

Within a few minutes after the first manifestation of the local affection, marked evidence appears of the absorption of the poison into the system. The patient looks excessively pale, sees objects indistinctly, is sick at the stomach, perhaps ejecting its contents, and has frequent swooning fits, with clammy sweats, and coldness of the body. By and by, as the system becomes more fully impressed with the deleterious effects, insatiable thirst arises; a sense of constriction is experienced in the chest; the breathing is oppressed; the pulse is feeble and vacillating; great anxiety and restlessness exist; the tendons twitch; the mind wanders, or is furiously delirious; and death soon closes the scene. In the worst cases of the affection, a universal yellowness of the skin is observed, and the parts are not only frightfully swollen, but, if the patient survive some hours, large vesicles appear upon the surface, containing bloody serum, and indicating the approach of mortification. When death does not take place for a considerable number of days, large abscesses form in the cellular substance and among the muscles, and the system gradually sinks under the resulting irritation.

The appearances presented in the bodies of those who die from the effects of this poison are pretty uniform. In the birds, rabbits, guinea-pigs, and dogs, experimented upon by Dr. Mitchell, extravasation of blood and softening of the tissues in the neighborhood of the bite were almost invariably observed; the brain and spinal cord were more or less injected; the heart was distended and flabby; the lungs were sometimes engorged; and the intestines were occasionally ecchymosed. In several instances, the kidneys were filled with blood, and exhibited all the evidences of acute congestion. The ureters and bladder contained sanguineous urine. The blood in the heart and vessels was dissolved, and of a dark color.

The genus *trigonocephalus* includes several species, of which the water moccasin, or cotton-mouth, and the copperhead, are the most important. They have no rattles, but the upper jaw is armed with poisonous fangs, and their bite is said to be very deadly. The cotton-mouth snake is met with extensively in the Southern States, its northern limit being the Pedee River in North Carolina. Professor Holbrook states that it is the terror of the negroes about the rice plantations, being more dreaded by them than the rattlesnake, which only attacks when irritated, whereas the water moccasin makes war on everything that comes within its reach.

Of the genus *elaps*, the only species, according to Dr. Holbrook, known in this country, is the elaps fulvius, whose body, twenty inches in length, is of a beautiful red color, surrounded with black rings, margined with yellow. Its upper jaw is armed on each side with a permanently erect poisonous fang. It is found chiefly in the Southern States, in sweet-potato fields, and is so gentle in its habits as to be regarded as almost harmless.

The most noxious serpent in the East Indies is the *cobra di capello*, the spectacled or hooded snake, of which there are a number of varieties, all distinguished for their venomous properties. The effects of its bite are very similar to those which follow the bite of the rattlesnake, only that they are in general somewhat more tardy, and accompanied by less swelling. The poison is of a semi-transparent, yellowish appearance, not unlike olive oil. It has been known to kill a large dog in less than twenty minutes; and in the case of the keeper at the Zoological Gardens in London, who was bitten by a cobra on the root of the nose, death occurred in ninety-five minutes. The internal viscera were found, on dissection, to be intensely congested, and the blood, which was dark, alkaline, and fluid, emitted a peculiarly acid and sickening smell.

In Europe, the common *viper* is the most venomous serpent known. It is uncommon in England, but exists in considerable numbers in France, Spain, and Italy, as well as in several of the more northern States of the Old World. The poison, which has a yellowish oily appearance, may be swallowed almost with impunity, provided there is no abrasion upon the mouth. It is most active in hot weather, killing small birds and animals almost instantly. Applied to the human subject, it causes acute pain and diffuse swelling, followed by a puffy, œdematous state of the subcutaneous cellular substance, and a livid and vesicated condition of the skin. The general symptoms, which seldom manifest themselves under three-quarters of an hour to an hour, bear so close a resemblance to those produced by the wound of the rattlesnake as to render it unnecessary to describe them.

A great deal has been written concerning the *treatment* of wounds inflicted by venomous serpents, and yet it is remarkable that we have not a solitary remedy upon which any reliance can be placed. The fact that so many articles have been recommended as specifics clearly shows that these lesions are often so slight as not to require any treatment at all, the unpleasant effects generally passing off spontaneously in a few hours, either because the poison has not been introduced in sufficient quantity, or because it has not been sufficiently noxious to produce any serious harm. The first thing to be done, as far as the part is concerned, is to constrict the limb as tightly as possible, a short distance above the wound, which is then to be instantly excised and cupped, the glass being retained as long as the blood is disposed to flow, when the surface should be well washed with the dilute tincture of iodine, the same remedy being thoroughly applied to the skin over the whole extent of the swelling. Subsequently, warm water-dressing, medicated with laudanum and acetate of lead, will form the most suitable application.

The practice of sucking the wound is of great antiquity, and we find that there have been men, from time to time, in different parts of the world, who have made it their special occupation. The Psylli of Africa and the Marsi of Italy, acquired great celebrity for their skill in this particular branch of business, and the custom still prevails among many of the Indian tribes of this continent. The operation, however, cannot be performed with safety if there be any abrasion upon the lips or in the mouth, and should therefore always give way to the cupping glass.

Professor Brainard, of Chicago, has suggested the practice of injecting a solution of iodine under the skin for the purpose of [illegible]. The only objection to the procedure is the difficulty of [illegible], such accidents nearly always happening in places remote from the apothecary and the surgeon.

Pain must be relieved, and the strength supported by [illegible] and alcohol, the latter being given, in any of its more common forms, to the fullest possible extent compatible with the patient's [illegible] seems to be the great remedy among the [illegible] this class of wounds, and there can [illegible] in the public prints upon the subject, that it is entitled to great consideration. The treatment should be rapidly pushed to gentle inebriation, though such an occurrence is seldom to be looked for when there is such marked depression of the general system as so often attends this lesion. Ammonia might, perhaps, be advantageously combined with the alcoholic remedies, for there can be no doubt that it must, under such circumstances, be productive of benefit, whether we regard it merely as a stimulant, or as a neutralizer of the poison. When there is excessive prostration, along with great gastric irritability, enemata of brandy and laudanum should be employed. Olive oil has been highly recommended as an antidote against snake bite; but, there is no reason to believe that it possesses any such virtues. In the East Indies, the Tanjore pill formerly enjoyed great celebrity in the treatment of wounds inoculated with the poison of the cobra di capello and other noxious serpents, its efficacy being supposed to depend upon the arsenic which enters into its composition. Fowler's solution has also been much lauded for its supposed neutralizing qualities, especially of the poison of the fer-de-lance, a venomous serpent in the Island of St. Lucia; it is administered every three hours in doses of two drachms along with a small quantity of laudanum, until active vomiting and purging are induced. But none of these remedies are reliable, and my opinion is that no time should be wasted upon their exhibition.

In the former edition of this work attention was directed to the use of Bibron's antidote, as it has been called,—a mixture of bromine, iodide of potassium, and bichloride of mercury—as a means of neutralizing the effects of the poison of the rattlesnake; but it has been ascertained by Dr. Mitchell that it possesses no such properties; nor are arsenic and ammonia, or, indeed, any other known articles of the materia medica, endowed with such virtues. In regard to topical remedies, he found, experimentally, that iodine, injected subcutaneously, exerted a great influence over the local effects of the venom, but none in preserving life or defending the system at large. Some simple astringents also possess this power, and are as useful as iodine itself. Among the internal stimulants, he assigns, in common with all American practitioners, the highest position to alcohol, looking upon it, not as a chemical antidote, or neutralizer of the venom, but as a great supporter of the vital powers. When the patient is too weak, or too sick, to swallow, he recommends it to be given as an enema; and he also, in that event, advises the inhalation of hot alcohol, or even of ether, as a means of re-exciting the flagging powers of the system. When the patient has recovered from the immediate effects of the poison, quinine and a nutritious diet will be necessary, along with the spirituous stimulants, to aid restoration.

Finally, it may be observed, in regard to the so-called antidotes for snake-bite, that the remedies which have, from time to time, been invested with this virtue, doubtless owed their temporary reputation to the fact that the cases in which they were used were cases of a comparatively slight character, which would probably have recovered as well, or nearly as well, without as with their use. The history of surgery certainly warrants this conclusion.

3. WOUNDS INFLICTED BY RABID ANIMALS.

There is a peculiar disease among man and animals known by the name of hydrophobia, its characteristic symptoms, at least in the human subject, being a dread of water, as the term by which it is generally designated literally signifies. It is due to the influence of a particular poison, generated by certain animals, and capable of propagating the disease by inoculation. Of the nature of this poison all we know is that it is contained in the saliva, and that, after having remained latent for some time in the wounded part, it is absorbed and carried into the system, where it produces the peculiar effects by which the malady is distinguished.

That the *virus* of hydrophobia resides in the saliva, or in the saliva and other secretions of the mouth and fauces, is a circumstance which has been fully established by experiments upon inferior animals. Thus, Dr. Zine inoculated a dog, cat, hare, and cock, with the saliva of a rabid dog, and readily induced the disease. Similar results followed the investigations of Dupuy, Youatt, and other veterinary surgeons. The former of these writers rubbed a sponge wet with the saliva of a mad dog upon the sore of a sheep, which subsequently perished from hydrophobia; and the latter communicated the affection from one brute to another by means simply of a silk thread, impregnated with this fluid and used as a seton. While hydrophobia, however, may be readily propagated in this manner, we are ignorant as to the precise source of the poison, whether, although it is contained in the saliva, it is really secreted by the salivary glands, or whether it is derived from the mucous membrane of the mouth and fauces. The former supposition is certainly the more plausible of the two, but the fact could only be verified by taking the fluid directly from one of these organs; an experiment which, so far as I am aware, has never been made.

There are certain animals which have the faculty of generating the poison of hydrophobia spontaneously; they belong chiefly, if not exclusively, to the canine tribe, and consist of the dog, wolf, fox, jackall, and badger. The cat is commonly supposed to possess a similar power, but this is still an unsettled question. Man and other animals do not produce the virus spontaneously, but are susceptible of the disease, and, with the exception of man, are probably all capable of propagating it when under its influence. Breschet repeatedly provoked the malady in dogs by inserting the saliva of rabid horses and asses; and several cases have been reported of human beings having suffered from the bite of rabid horses and pigs. It is uncertain whether hydrophobia can be communicated from one person to another. In the case of Mr Wheeler, a dresser in Guy's Hospital, London, who was bitten by a rabid patient, no ill effects followed, and I know of no well authenticated instance of the disease having been induced in this wise. Rabbits and similar animals, as well as fowls, soon die from inoculation with this poison, without exhibiting any of the ordinary symptoms of hydrophobia.

The *inoculation* in hydrophobia is usually effected by a tooth, which, however, need not necessarily penetrate the true skin, numerous cases having occurred where the disease was communicated by the slightest scratch, or abrasion. One instance has been reported where death was produced by the licking of a wart upon the face, by a little poodle supposed to be laboring, at the time, under rabies. It is, indeed, not improbable that the disease may be communicated merely by the contact of the saliva of a hydrophobic animal with sound skin and mucous membrane. It is also supposed to be possible that a mother may transmit the affection to her infant through her own milk. Cases now and then occur which lead to the suspicion that the disease may be induced by dogs and other animals not actually mad, but simply enraged: whether this, however, be a fact or not remains to be proved. Finally, experiments have been performed which go to show that the morbid saliva may be administered internally with entire impunity.

The period of *latency* of this disease varies from a few weeks to several months. In 89 cases, analyzed by Dr. Blatchford and Dr. Spoor, of Troy, the average period was about seventy days, the minimum in 23 cases was thirty days and under, and the maximum in 6 cases was upwards of two hundred days. In the only two cases of hydrophobia that I have ever seen, the disease appeared, in one, at the end of four weeks, and in the other at the end of nine months from the date of the inoculation. According to John

Hunter, the extremes range from thirty days to eighteen months. An English writer, Dr. Bardsley, refers to an instance where the disease did not show itself for twelve years, but such a statement must be received with great allowance. The period is generally considerably shorter in animals than in man, and in very young persons than in adults.

Although a considerable period always elapses between the inoculation and the appearance of hydrophobic symptoms, yet it is extremely probable that the virus is speedily absorbed into the system, though some time is necessary to develop its zymotic properties. What countenances this view of the subject is that nearly all the other known poisons, when brought in contact with the living tissues, are promptly absorbed, so as to make, sooner or later, their peculiar impression upon the constitution. The poison of the rattlesnake is taken up almost instantaneously, and the probability is that the same is true with respect to the poison of smallpox, measles, scarlatina, and other zymotic affections. A certain period, however, is necessary, in every case, to enable the poison to explode upon the general system, or, in other words, to multiply itself, and extend its influence. With regard to the virus of rabies, it is certain that the disease is often developed within the usual period, after the most prompt and complete excision of the bitten parts.

Many persons are bitten by rabid animals who yet never contract the disease, the virus having either been exhausted before the rencontre takes place, or, what is more probable, having been wiped off by the clothes in the act of inflicting the wound. In this way more than half of those bitten occasionally escape with impunity; but, on the other hand, it sometimes happens that nearly every one is effectually inoculated. It is not impossible that idiosyncrasy may exert an important influence in the production of the disease. It is well known that this is true of other zymotic poisons, and it is therefore reasonable to suppose that it may also hold good of this. Out of fifty dogs that had been inoculated by Dr. Hertwich, of Berlin, with saliva taken from a rabid animal of the same species, not one in five was infected.

Hydrophobia occurs at all *ages*. It has been observed in infants at the breast, in children, and at every period of adult life. In the Transactions of the American Philosophical Society are the particulars of a case in a man of seventy-three. Women are equally as subject to the disease as men, and, if they suffer less frequently from it than they do, it is simply because they are less exposed to the attacks of rabid animals. It prevails in all countries, in all climates, and at all seasons of the year. Northern Europe, however, has furnished a greater number of cases than perhaps any other part of the world. It is also frequent in England; and, as a general rule, it is more common in northern than southern regions. Throughout the West Indies it is comparatively rare, although the number of dogs there is unusually great as compared with the number of inhabitants. Hydrophobia is more common in Canada and New England than in the Southern States of the Union.

The *symptoms* of rabies necessarily divide themselves into local and constitutional; or those furnished by the wounded part, and those afforded by the system, after the absorption of the specific virus.

The wound inflicted by a rabid animal generally heals as kindly as any similar wound made by a sound animal; the scar, perhaps, remaining a little red and tender, as it usually does after an ordinary bite, but exhibiting no other peculiarity, and the system being perfectly free from disease. By and by, however, when the period of incubation is about to draw to a close, the part begins to itch, burn, or smart, and soon becomes sore and irritable, hot, numb, or rigid, pain darting through it in different directions, and sometimes extending to a considerable distance beyond the site of injury, as from the hand up to the shoulder, or from the foot to the knee or groin. Sometimes a red line can be traced in the direction of the lymphatics. Occasionally, after having been bitten in the left hand by a rabid dog. When I was called in, the disease was in its second stage, well-marked symptoms having appeared the previous day. The difficulty of swallowing and the morbid sensibility of the skin were present in a high degree. Every effort at drinking, nay, the very mention of fluid of any kind, and the attempt to raise the glass to the lip, caused violent convulsions; the countenance was flushed and tumid; the eyes red and suffused; the mouth parched; the throat stopped with viscid mucus; the pulse frequent and rather strong; the respiration hurried; the thirst and restlessness intense; the mind exceedingly peevish and irritable; and the sensibility of the skin so exalted that the slightest approach of a current of air, inappreciable by any one else, produced the most horrible torture. The inability to bear light and noise was also very great. The hand felt numb and painful, though the wound had not reopened. These symptoms gradually progressed, increasing steadily in severity, until towards the end of the third day from the attack, when the young man expired in a state of complete exhaustion. The pulse, during the latter stage of the malady, was exceedingly irregular, and upwards of one hundred and fifty in the minute; the breathing was short and panting; and the mind was excessively agitated and distressed, but clear and intelligent, except when the patient was on the verge of a convulsion. The voice was not materially affected.

It is impossible to mistake hydrophobia for any other disease. The dread of water, the difficulty of deglutition, and the dread of cold air, are always sufficiently diagnostic of the affection, even when no history of it can be obtained.

The *dissection* of persons dead of this disease has thrown no real light upon its seat and pathology. In the case of a young man of twenty-four, who died in 1840, nine months after he had been bitten on the hand, and whose body I assisted in examining, no lesion whatever could be detected, by the closest scrutiny, anywhere. The mouth, fauces, pharynx, and œsophagus, the larynx, trachea, and bronchial tubes, where disease might naturally be supposed to exist, under such circumstances, were perfectly free from morbid appearances. The brain and spinal cord, the lungs, stomach, bowels, and other viscera, were in as natural a condition as I ever saw them in any case. Occasionally, especially in protracted instances, the membranes of the brain have been found congested, and the ventricles partially filled with serum. The stomach, œsophagus, and pharynx have also been found inflamed; and several dissections are mentioned where pus was discovered in some of the larger joints. Very little reliance, however, it seems to me, should be placed upon the statements that have been published upon the subject, especially when we consider the loose manner in which most of them are drawn up, and the fact that comparatively few men are competent to make accurate dissections of dead bodies.

The *prognosis* of hydrophobia is always bad, the disease invariably ending fatally. If there is a case of recovery, of a reliable character, upon record, I am not aware of it. I know that a number of instances have been published in which the patient is said to have gotten well, but there is not a single one, so far as I am acquainted with them, that can withstand the test of scientific scrutiny.

The period at which death occurs is, in general, very short. The average in 72 cases, analyzed by Dr. Blatchford and Dr. Spoor, was three days. In 120 cases, analyzed by Dr. J. L. Smith, of New York, 65 perished in from one to two days. In some instances, the disease proves fatal during the first twenty-four hours, while in others this event does not happen until the tenth day, although when postponed so late it necessarily creates some doubt in regard to the true nature of the case.

:tained for some time, when the raw surface is well cleansed, and im-
ly cauterized with nitrate of silver. If the teeth of the rabid animal netrated between two bones, as, for example, when the bite has been upon the hand, excision must be performed with increased care, se a portion of virus will be almost sure to be left behind. In such t might become a nice question to determine whether the operation not be made to include a portion of the bones also; for almost any crifice is justifiable to secure immunity from so horrible a disease. It eem from the observations of Mr. Youatt and Mr. Blane, two eminent .ry surgeons, that there is no remedy which so certainly neutralizes son as nitrate of silver. The former of these writers, whose opinion ed to the greatest respect, on account of his large experience in the nt of canine madness, has repeatedly employed this article, under these tances, in his own case, and such is his confidence in its virtues that rds it in the light of a specific. His plan is to cleanse the parts well irst instance with soap and water, and then to use the caustic most hly, previously enlarging the wound, if necessary. If I were so un-
e as to receive such an injury upon my own person, I should certainly e confidence in my escape, if the wounded parts had been excised and prior to the cauterization.

ion should also be practised when the injured part has been neglected, rfectly removed in the first instance, it being well known that the al may escape the constitutional effects of the disease even after the as partially reopened. But even if there were no reasonable hope of ing the occurrence of the disease by this procedure, it should, never-
be practised, if for no other reason than that it will have a soothing pon the mind of the poor sufferer. Everything calculated to allay his d contribute to his happiness is justifiable under such trying circum-
If the symptoms of hydrophobia, however, are already developed, such an operation, nor even the amputation of the limb above the site y, will be of any service.

a the poison has reached the system, and has evinced its explosive no treatment, however judiciously and perseveringly conducted, can ay avail as a curative agent. The experience of two thousand five l years fully attests the truth of this statement. There is hardly an of the materia medica, potent or impotent, vegetable or mineral, that been used, singly or combinedly, for the cure of this disease, and yet, mentioned in a previous paragraph, there is not one solitary instance, patient's body as he lies in bed; and the exclusion of cold air, noise, and light from the apartment, constitute the most reliable means. General bleeding, the hot bath, and tartar emetic, so much vaunted by some, will only, as a general rule, expedite the fatal issue, without affording any decided mitigation of the suffering. Opium is of no use, even if given in enormous quantity, as the stomach does not appear, in this disease, to have the power of dissolving it. If anodynes are exhibited at all internally, they should be used in the form of morphia, laudanum, or black drop. Dr. Physick, with a view of relieving the difficulty of breathing, and preventing suffocation, advised laryngotomy, but I am not aware that it has ever been practised, or, if practised, that it has ever done any good. It certainly could not cure the disease, and it admits of doubt whether it would even moderate the spasm.

Hydrophobia in the Dog.—In concluding the subject of hydrophobia, a few words may be said respecting the character of this disease as it occurs in the dog, as it is important for the practitioner to be able to judge of the probability of his having been mad in the event of his having bitten a human being.

How the disease originates in the dog, one of the animals in which it is generated spontaneously, is not ascertained. It has been supposed that sexual abstinence, the use of filthy and unwholesome food, too close confinement, and extremes of heat and cold, constituted so many causes of the malady; but it is obvious that, although this may be true, yet our knowledge at present amounts to nothing but conjecture, which further and more carefully conducted observation alone can either verify or disprove. The average period of incubation is about forty days, the minimum being a fortnight, and the maximum three months and a half.

The early symptoms of rabies in the dog are thus graphically described by Mr. Youatt: "In the greater number of cases," he remarks, "there are sullenness, fidgetiness, and continual shifting of posture. When I have had opportunity, I have generally found these circumstances in succession. For several successive hours perhaps he retreats to his basket or his bed. He shows no disposition to bite, and he answers the call upon him laggardly. He is curled up, and his face is buried between his paws and his breast. At length he begins to be fidgety. He searches out new resting-places; but he very soon changes them for others. He takes again to his own bed; but he is continually shifting his posture. He begins to gaze strangely about him as he lies on his bed. His countenance is clouded and suspicious. He comes to one and another of the family, and he fixes on them a steadfast gaze as if he would read their very thoughts. 'I feel strangely ill,' he seems to say: 'have you anything to do with it? or you? or you?' Has not a dog mind enough for this? If we have observed a rabid dog at the commencement of the disease, we have seen this to the very life." Delirium is an early and characteristic symptom; the dog sees imaginary objects, and often springs at them with a furious dart; he is restless and excessively irritable, gazing wildly around, and snapping at everything within his reach. The saliva is secreted profusely, and collecting at the corners of the mouth, the animal makes frequent attempts to detach it with his paws; his appetite is strangely perverted, and he will sometimes greedily devour horse-dung, or even his own excrements; the voice is changed in its character, being generally hoarse, and more or less shrill: the eyes are singularly bright; and the thirst is intense and insatiable, the dog drinking frequently, and having no fear whatever of water, as is the case with the human subject.

The disease is now in full force, and tending rapidly to a fatal issue. The muscular powers being greatly exhausted, the animal finds it difficult to sustain himself upon his limbs; he reels and staggers about like a man in a drunken fit; his tail is depressed, and the tongue protruded; the eyes have lost their brightness, and are of a dull, glassy appearance; the respiration is hurried and panting; finally, worn out by his suffering, the poor creature dies, either from convulsions, or from sheer exhaustion, the duration of the attack varying from three to five days. The power of communicating the infection exists, according to Youatt, in all the confirmed stages of the disease, and continues even for twenty-four hours after the death of the animal.

4. GLANDERS, FARCY, OR EQUINIA.

The horse, ass, and mule are capable of spontaneously generating a disease, which, although it affects the whole system, expends itself with peculiar force and virulence upon the mucous membrane of the nose, causing violent inflammation and a copious discharge of thick, fetid matter. It is accompanied by a pustular eruption of the skin; and the name by which it is generally known is glanders, from the fact that it is always associated with disease of the maxillary glands and of the lymphatic ganglions of the ear and neck. There is a form of the affection which is characterized by the development of small tumors beneath the skin in different parts of the body, varying from the size of a pea up to that of a hazelnut, of a spherical shape, very hard, almost immovable, and generally exquisitely painful to the touch. When very numerous, they give the surface a remarkably tuberculated appearance. To this disease the term *farcy* is commonly applied; and an attempt has been made by several writers to establish for it a distinctive character. Others, on the contrary, assert that it is identical with glanders, differing from it only in its location, or in the character of the structures in which it appears. This view of the case derives confirmation from the fact that the two affections often coexist, which would hardly happen if they did not possess a strong natural affinity for each other.

It has been observed that the animals in which this disease arises spontaneously are generally half-starved, over-worked, and of broken constitution. Whatever, however, the cause may be by which the affection is originally engendered, it is certain that it is both contagious and infectious, and that the strongest and most healthy animals will often speedily contract it when exposed to its influence; confinement in damp and ill-ventilated stables, especially if underground, powerfully predisposing to its occurrence. It was at one time thought questionable whether the disease could be propagated by atmospheric agency; but multiplied observation long ago fully settled that point. It would seem, indeed, that the air of an infected stable, after all the wood work, pavement, and plastering have been completely replaced, and every possible precaution used in regard to cleanliness, is capable of reproducing the disease in all its former severity.

The fact that glanders may occur in the human subject was first enunciated by Mr. Muscroft, in the Edinburgh Medical and Surgical Journal, in 1821. The case which he therein reports was that of a man who had accidentally inoculated his hand in cutting up for the kennel a horse that had died of this disease; violent symptoms soon showed themselves, and he expired in great agony at the end of a week. Since that time a number of similar examples have been recorded by other observers, thus indisputably establishing the transmissibility of glanders from animals to the human subject. As yet no facts had occurred proving that the affection might be communicated from one human being to another, or from man to beasts. In 1840, however, a case of this kind took place at St. Bartholomew's Hospital, London, which conclusively settled the question. The patient, a knacker, died of glanders, and the nurse who attended him took the disease and also perished from it.

These facts regarding the transmissibility of glanders from animals to man, from man to man, and finally from man to beast, are of great pathological interest, and serve to inculcate the indispensable necessity of caution on the part of the professional attendants and nurses in their intercourse with individuals laboring under this horrible disease; since the smallest particle of the specific virus coming in contact with an abraded surface, or even the mere inhalation of the infected air of the patient's apartments, may give rise to the malady.

In the equine tribes of animals, glanders may be propagated by *inoculation* with the pus and mucus of the pituitary membrane, the fluids being inserted under the skin with a lancet, or rubbed upon the greasy heel of the horse. It may also be produced by applying these secretions to the mucous lining of the nose; and a curious case has been reported of its having been caused by introducing balls of farcied matter into the stomach. An experiment performed by Mr. Coleman, the distinguished veterinarian, shows that the blood of a glandered animal transfused into the carotid artery of a sound one, will rapidly engender the malady in its most virulent form.

The period of *latency* of this disease is generally very short, rarely exceeding two or three days. It is probably a little longer in the human subject than in animals, but the difference, if any, is very slight. It has already been seen that the first case that ever occurred, so far as is ascertained, in the human subject, terminated fatally at the end of a week from the time of the inoculation. The first local evidence of the disease is generally some swelling and tenderness of the maxillary glands and inflammation of the mucous membrane of the nose; sometimes the one, and at other times the other, taking precedence.

The *symptoms* of glanders naturally divide themselves into constitutional and local. Shortly after the inoculation has taken place, the patient begins to feel unwell; his head, back, and limbs ache; chilly sensations, alternating with flushes of heat, creep over his body; sleep and appetite are impaired; the strength sensibly diminishes; the joints are stiff and sore; the spirits are depressed; the stomach is irritable; and the bowels are costive. After the lapse of thirty-six to forty-eight hours, sooner or later, a severe and protracted rigor generally occurs, followed by violent fever and profuse perspiration; an evidence that the stage of incubation is passed, and that the poison has gained full admission into the system. The symptoms now rapidly assume a typhoid character. The pulse becomes quick, frequent, and tremulous; the tongue is dry and brownish; sordes accumulate upon the gums and teeth; the voice is weak and often husky; the respiration is short, panting, and accompanied by a sense of constriction across the chest; the surface is bathed with fetid, clammy perspiration; the thirst and jactitation are excessive; the urine is scanty and high colored; the alvine evacuations are slimy and excessively offensive; the mind wanders; and the pains are atrocious.

Coincident with these phenomena are marks of serious disease of the mucous membrane of the nose, which is highly inflamed, and the seat of a copious, viscid, and irritating discharge. Excessive pain and soreness exist in the forehead, over the frontal sinuses, evidently from an extension of the inflammation to the lining membrane of those cavities; and for the same reason there is generally great uneasiness in the throat and larynx. The nose and cheeks soon become hot, swollen, purple, excoriated, and exquisitely painful; the discharge from the nostrils assumes a bloody, purulent character, and is both copious and disgustingly offensive; the eyelids are infiltrated and nearly closed; and the features are hideously disfigured. About the tenth or twelfth day hard pustules make their appearance on various parts of the body, especially on the trunk, face, genital organs, and inside of the limbs, resembling those of smallpox, and attended with profuse fetid sweats. Occasionally they are accompanied by black bullæ, which, breaking, discharge a thin, sanious fluid, and bring into view gangrenous spots, varying from the [illegible] of a dissection wound it may be readily distinguished by the [illegible] discharges from the nose, and by the character of the cutaneous eru[illegible] The history of the case, too, will furnish important diagnostic data, [illegible] always receive due consideration. The fact that the p[illegible] has nursed or examined a glandered horse or person, will generally of [illegible] strong presumptive proof of the true character of the attack. I[illegible] later stages of the disease, the nasal discharges, the existence of pus [illegible] abscesses and gangrenous spots, and the horribly fetid exhalations fro[illegible] body, are signs which it is impossible to mistake.

The character of the prognosis in this disease may be gathered, in [illegible] measure, from what precedes. The acute form of the disease is nearly a[illegible] [illegible] Of fifteen cases collected by Rayer, one only recovered. The d[illegible] [illegible] glanders, on the other hand, is much less. Thus, of ten [illegible] mentioned by the same writer, seven recovered and three died.

The treatment of this affection is preventive and curative. The forme[illegible] [illegible] in the adoption of proper measures for destroying the poison as spe[illegible] [illegible] after the inoculation. With this view the affected or ab[illegible] surface should be freely washed by holding it for a considerable leng[illegible] [illegible] a continued stream of water, and then thoroughly caute[illegible] with acid nitrate of mercury, or some other active escharotic, or, w[illegible] better, effectually excised. If the operation be impracticable, and the w[illegible] is a punctured one, it should at once be enlarged, and then br[illegible] under the influence of some caustic, otherwise a portion of the p[illegible] [illegible] in the wound may escape its contact, and thus be abs[illegible] into the system. If a person is known to have died of glanders, the [illegible] practitioner should avoid a post-mortem examination, especia[illegible] [illegible] any abrasions, however slight, upon his hand and fingers.

The curative treatment, if it deserve such a name, has hitherto been en[illegible] [illegible] Bleeding, both local and general, purgatives, tonics, and s[illegible] [illegible] alike useless. Obviously our chief reliance must be [illegible] supporting measures, especially quinine, carbona[illegible] [illegible] the chloride of iron and brandy, given in large [illegible] doses, in combination with liberal quantities of morp[illegible] [illegible] allaying pain and controlling gastric irritability. [illegible] abscesses should be promptly evacuated, and the aff[illegible] [illegible] saturnine and anodyne lot[illegible] [illegible] frequently [illegible] with tepid water impregnated [illegible] chlorinated soda should be f[illegible] [illegible] the apartment should be const[illegible] [illegible] should be paid to cleanliness. To [illegible] [illegible] change of air, or residence nea[illegible] [illegible]

WOUNDS INOCULATED WITH A PECULIAR SEPTIC POISON GENERATED I[illegible] DEAD ANIMAL BODIES.

1.—*Dissection Wounds.*

Wounds contracted in the examination of dead human bodies are n[illegible] [illegible] wounds, and are deserving of special attention from the s[illegible] [illegible] These injuries generally occur i[illegible] [illegible] abrasions, or slight incisions, and would, in gener[illegible] [illegible] if it were not for the fact that they are often i[illegible] [illegible] septic in its character, and therefore liab[illegible] [illegible] to the part and system. The instruments [illegible] are the scalpel, tenaculum, and needle, espe[illegible] [illegible] the latter, as it is very apt to prick the fingers in sewing up dead bodies. Not unfrequently the inoculation is effected through the medium of a pre-existing abrasion, or scratch, of the presence of which the person may, at the time, be perfectly unconscious.

Of the *nature* of the poison which produces these severe effects nothing whatever is known. It is supposed that it is generated a short time before death, during the act of dying, or soon after dissolution, and that it is dependent for its development upon a vitiated state of the blood, though that state has not been pointed out. The idea is certainly plausible, supported as it is by the circumstance that the poison is generally most virulent when it is communicated by persons dead of puerperal fever, erysipelas, carbuncle, pyemia, carcinoma of the liver, and other kindred affections. Once formed, it becomes, like the virus of chancre, independent of the source whence it was derived. A good illustration of this fact was afforded me, a few years ago, in the person of a young cutler, who, in sharpening a case of dissecting instruments for me, which had not been used for nearly five months, slightly pricked one of his fingers. The consequence was that the hand and arm soon became exceedingly painful, as well as a good deal swollen, a characteristic red line extending up as high as the axilla, the glands of which were also in a short time involved in the disease. Nearly a month elapsed before he recovered from the immediate effects of his injury. A prick of the finger received in cleaning bones has sometimes been followed by severe suffering, and even loss of life. It is generally supposed that fresh bodies are more liable to convey the poison than such as have been kept for some time. This, however, is not always true; for in a subject which had been on hand for nearly a month, and which I dissected, in 1827, with Dr. Temple, of Virginia, that gentleman came very near losing his life from a little puncture which he received at the end of that time. It is worthy of remark that the body was that of an old female, who had perished from the effects of tertiary syphilis, as was apparent from the extensive disease of the skull and other portions of the skeleton, and that the attack of my friend was one of extraordinary severity.

Violent effects sometimes follow the dressing of wounds, in consequence of the contact of foul and irritating discharges, and several instances are upon record where surgeons have lost their lives from this cause. Similar results occasionally occur during the removal of cancerous growths, from inoculation with the secretions of the affected structures. The health of Professor Dudley, of Lexington, suffered seriously for several years from the inoculation of the hand with the matter of an encephaloid tumor during the amputation of an arm, performed for the purpose of getting rid of the disease. Dr. Physick met with a case where death occurred from the effects of a slight scratch with the shell of an oyster, received in the act of opening the animal.

The period of *latency* of this poison is usually very brief, or, more properly speaking, only a short time elapses before the occurrence of well-marked symptoms; for it is extremely probable that it begins its peculiar operation upon the inoculated structures almost immediately after its introduction, although its explosive effects may not manifest themselves nearly so soon. Generally they do not come on before the end of the second day, or the commencement of the third. In one case—the most remarkable, in this respect, on record—the symptoms were quite severe within the first twelve hours, and the patient died in forty hours from the receipt of the wound. In the case of Dr. Temple, above alluded to, violent indisposition ensued in less than thirty-five hours from the time he pricked his thumb. The accident happened late on a Saturday night, and on the following Monday morning, on his way to the college, he was taken so ill that he was obliged immediately to return to his room, which he did not leave again for nearly two months. In the case of young Kissam, a medical student of New York, related by the late Dr. Godman, violent symptoms supervened in less than fifteen hours, although death did not occur until the fifth day. On the other hand, the patient occasionally remains free from suffering for a comparatively long period, as in the instance of Mr. Newby, an English surgeon, who punctured himself in opening the body of a child dead of enteritis, where no serious inconvenience was experienced until the commencement of the fourth day.

There is no question that some persons are peculiarly prone to suffer from this poison. I am acquainted with a physician who was formerly much engaged in pathological researches, who rarely opened a dead body without having a dissection boil upon his hand, thumb, or finger. Occasionally the consequences were more serious, the disease extending up the arm, along the course of the absorbents, as high as the axilla. Disordered health, hard study, general debility, mental anxiety, and other causes, no doubt, powerfully predispose to the development of the disease. A student who has for weeks inhaled the foul atmosphere of the dissecting-room, taken little exercise, and sat up late at night, eating, perhaps, withal, very heartily, will be much more likely to contract the disease, and to suffer severely, if he wound himself, than one who has taken better care of himself.

Symptoms.—The usual point of departure of this disease is the inoculated part, from which it rapidly spreads in every direction. A smarting, stinging, or burning sensation is generally the first circumstance which attracts attention. Upon looking at the part, it is found to be covered with a little whitish vesicle, perhaps hardly the size of an ordinary pin's head, filled with serum, and resting upon a hard, reddish base, extremely sensitive on pressure. When this vesicle breaks, as it usually does in twenty-four hours, a small ulcer is exposed, having a foul base, and discharging a thin, sanious fluid. The pain by this time is generally very distressing, burning, and pulsatile, depriving the patient of appetite and sleep; the sore enlarges; the swelling augments; and the surface feels exceedingly hot, tense, heavy, and numb. Generally a red line is seen extending from the seat of the inoculation along the arm to the axilla, marking the course of one of the absorbent vessels. As the poisonous influence spreads, the whole limb becomes enormously enlarged, pitting on pressure, and exhibiting a dusky, erysipelatous appearance. With this increase of swelling there is a proportionate increase of pain, which now amounts to torture; the limb feels like a mass of lead, and is completely deprived of the power of motion. In bad cases the inflammation extends to the top of the shoulder, the axilla, and even to the corresponding side of the trunk.

Such is the ordinary course of the disease; but cases occur where the order of the symptoms is reversed, the poison exploding in the axilla, and thence extending up the neck and down the side, the arm being, perhaps, almost free from inflammation, and there being no appearance, or only a very slight appearance, of disease at the seat of inoculation. The swelling, which sometimes reaches as low as the crest of the ilium, is, at first, of a doughy character, and of a pale pinkish hue; but it soon becomes hard, and assumes the peculiar erysipelatous blush already described as belonging to the more common variety. The pain is generally exquisite from the beginning, and is sometimes of itself sufficient to crush the system, before sufficient time has elapsed for the formation of the characteristic pustule. Such cases, which are always fraught with danger, have been known to terminate fatally in a few days.

It is not every case of inoculated dissection wound that gives rise to general symptoms; on the contrary, in the great majority of instances, the affection is altogether of a local character, being confined to the immediate neighborhood of the original injury, diffused over the hand and wrist, or, it may be, limited to a few absorbent vessels, as seen by the red lines extending up the limb. Under such circumstances the patient may feel a little unwell, have some headache, and want of appetite, or suffer from chilliness and aching of the limbs, but there will be no serious disturbance of the general health. This will, however, be sure to occur, if the virus has gained full admission into the system, the symptoms showing themselves, on an average, in from twelve to twenty-four hours. The patient, at first, has merely a feeling of depression, or faintness, with a sense of chilliness, pain in the head, and slight derangement of the digestive organs. This prodroma is speedily succeeded by violent rigors, alternating with flushes of heat, nausea and vomiting, excessive restlessness, intense thirst, an increase of cephalalgia, a haggard, wo-begone state of the countenance, and indescribable despondency. The tongue is coated, the respiration hurried, the skin dry and hot, and the pulse sharp and frequent, but feeble. The bowels are either constipated, or, as more frequently happens, harassed with diarrhœa.

The disease, in its worst forms, soon reaches its crisis, the system rapidly falling into a typhoid state. During this downward course the symptoms above described become more and more marked; the tongue dry and brown; the pulse quick and tremulous; the countenance sallow and withered; the skin yellow and covered with clammy sweat; and the suffering indescribably severe. Delirium always sets in at an early period, and is a prominent symptom throughout. Death occurs in a few days to a few weeks, according as there is overwhelming exhaustion, or depression from gangrene and metastatic abscesses.

The appearances discovered on *dissection* are variable. When the case has run its course very rapidly, the internal organs may, apparently, be entirely free from disease, or there may be evidence of slight effusion into the chest, with an engorged condition of the lungs, the affected structures themselves being somewhat infiltrated with serum and lymph. Under opposite circumstances, there will generally be marks of inflammation of the arachnoid membrane, of the pleura, lungs, and peritoneum, with, perhaps, deposits of pus in the larger joints, among the muscles, and in the subcutaneous cellular tissue. The parts more immediately involved in the morbid action will be found to be enormously distended with the ordinary products of inflammation, highly softened at some points and greatly indurated at others, with here and there an abscess, and, perhaps, a gangrenous spot.

The *prognosis* of this affection may be deduced, in some degree, from the preceding remarks. When the disease is strictly local, much suffering may be the consequence, but ultimate recovery will be certain, the part immediately affected becoming, perhaps, withered and completely useless, as often happens when the lesion is seated in a finger. In the very worst cases death may occur in less than forty-eight hours, from the empoisoned condition apparently of the nervous system, with little or no evidence whatever of local disease. In another class of cases, also very bad, the patient may live five or six days, and then perish from the violence of the resulting inflammation; or he may linger on for weeks and months, abscess after abscess forming in the limb, on the side, or in other regions of the body, and finally die from constitutional irritation; or, lastly, he may, after having been for a long time on the very brink of the grave, struggle through the disease, and in the end make a good recovery, or he may remain permanently weak, and crippled in some internal organ.

Some persons are a long while in recovering from apparently very trifling accidents of this kind, depending either upon some idiosyncrasy, or upon some derangement of the general health. I myself formerly suffered a great deal in this way. On one occasion my thumb, which had been accidentally pricked in examining the body of a woman dead of phthisis, remained sore for fifteen months; and a former colleague of mine, Professor Rogers, of Louisville, once had an affection of this kind upon one of his fingers which troubled him for upwards of three years. When the disease is thus protracted, the probability is that disorder of the digestive organs is essentially concerned in nursing its latent embers.

Treatment.—The treatment is preventive and curative. As soon as a wound of this kind has been received, the part must be most thoroughly washed, first with warm water and castile soap, and then by holding it under a stream of cold water, suction being at the same time performed with the mouth. If the wound be very small, or valvular, the best plan will be to dilate it, as a preliminary step, in order to facilitate the extraction of the poison. Whatever method be adopted, the operation is completed by effectual cauterization with the acid nitrate of mercury, inserted into the wound by means of a small pointed stick of wood. In the absence of this article, which I prefer to everything else for the purpose, use may be made of nitrate of silver, butter of antimony, hydrochloric, nitric, or sulphuric acid, or a saturated solution of equal parts of alum and nitre. Persons who are in the habit of suffering from dissection wounds should always employ some precautionary measures in examining dead bodies, such as anointing the hands well with pomatum, lard, tallow, or simple cerate, and even wearing thin leather gloves, any fluids that may be present being previously removed by an assistant. Fortunately, since the introduction of chloride of zinc injections now in such common use in our schools, suffering, in any form, from dissection wounds is much less common than formerly. In the Jefferson Medical College, no case of a serious character has occurred since this article first began to be used by Dr. Wallace, the able demonstrator of anatomy. The pupils of the other schools of this city have, I believe, been equally exempt.

If the case has been neglected, or if, in spite of the precautions here mentioned, a vesicle forms at the site of the wound, this should be at once opened by a free incision, when, bleeding having been encouraged by immersion in warm water, the part should be thoroughly cauterized with the nitrate of silver, or wet with the dilute tincture of iodine, an ectropic effect being still hoped for, though not likely to be attained. Warm water-dressing with laudanum is then applied, and the patient must take a brisk cathartic, keep quiet, and live light, watching the progress of events. If the disease extend, the indications will be to limit its action as much as possible, and to sustain the system under the approaching struggle. In view of the inevitable typhoid tendency, all exhausting remedies must be carefully withheld, especially the lancet and active purgation. If nausea and vomiting are present, a mustard and salt emetic, or an emetic of ipecacuanha is administered, and the bowels and secretions are regulated by mercurial laxatives, aided, if there be high fever, by tepid sponging of the surface, and the use of the neutral mixture. To relieve the excessive pain and restlessness, opium must be given in large and sustained doses, united, if there is much dryness of skin, with a little antimony or ipecacuanha. The distressing headache which so often attends the disease must be treated with cold applications to the scalp, the hot foot-bath, and the exclusion of light and noise; but anodynes will, in general, afford more ease than anything else. If inflammation of the arachnoid is threatened, a few leeches may be applied to the temple, or a blister to the nape of the neck. The moment typhoid symptoms appear, the proper remedies will be milk punch, quinine, iron, and ammonia. In the more terrible forms of the disease, commencing with violent pain in the axilla, side, and shoulder, these means should be used at once, in large quantity, especially the brandy, with the hope of neutralizing the poison, and thus arresting its zymotic tendency. Although we know nothing of the nature of this poison, yet it is not at all improbable, judging from the good effects which are said to attend the employment of alcohol in the treatment of snake bite, that brandy and other spirituous liquors might be of great service in dissection wounds. The suggestion, at any rate, seems to me to be worthy of attention. Their beneficial effects might possibly be increased by the free use of carbonate of ammonia; certainly by that of anodynes.

As it respects the parts more immediately concerned in the disease, the best remedies, after the first ten or twelve hours, will be the warm water-dressing, medicated with laudanum and Goulard's extract, acetate of lead, or hydrochlorate of ammonia, preceded and accompanied by the dilute tincture of iodine. Lint wet with oil of turpentine and laudanum sometimes affords great comfort. Blisters and nitrate of silver are objectionable, their vesicating effects interfering with other applications. Leeches are occasionally productive of great relief, but they are not to be used, except in very robust subjects, and in the early stage of the affection. When there is much œdema, the pressure of the bandage will be useful. Tension is relieved, and matter evacuated, by free and timely incisions.

Covering the parts thickly with strong mercurial ointment, along the whole track of the inflamed lymphatic vessels, is sometimes useful in arresting the spread of the morbid action, and promoting the absorption of effused fluids. Dr. Wallace speaks in terms of high commendation of this mode of treatment, and the facts which he has communicated to me warrant me in saying that it is worthy of fair trial in the early stages of every case of the disease likely to come under the notice of the practitioner.

The secondary effects of this class of injuries are removed by change of air, attention to the secretions, tonics, iodide of potassium, and cod-liver oil. In obstinate cases, a mild course of mercury may be necessary. The most eligible topical remedies are evaporating spirituous lotions, or lotions of acetate of lead, Goulard's extract, or hydrochlorate of ammonia. Sometimes a deep and free incision will afford more prompt relief than anything else.

b.—*Malignant Pustule.*

This is a disease of the cutaneous and cellular tissues, commencing in the form of a little vesicle, and rapidly terminating in gangrene, its cause being a septic virus generated by horned cattle laboring under murrain. The French surgeons usually describe it under the name of *charbon*, and in many parts of Europe it is vulgarly known by the term Persian fire, or malignant pimple, the former having reference to the horrible pain which attends it, the latter to its destructive tendency.

The disease is met with in various sections of the Union, though it appears to be less common here than in Europe. Cases of it have occasionally been noticed in this city and its vicinity, and I have myself seen it in Kentucky, where, as well as in Ohio, Illinois, Tennessee, Mississippi, and Louisiana, murrain sometimes prevails as an epidemic. In the latter State it caused great havoc, in the summer of 1851, among the stock of the parishes of St. Mary and Vermilion, carrying off an immense number of cattle, as well as a considerable number of horses and mules, among the latter of which it first broke out. Hogs and dogs that ate of the carcasses took the distemper, and soon died of it. Several cases occurred in which the disease was communicated to the human subject by the green carrion fly. During my residence at Louisville four cases of the malady came under my observation, all having been contracted in flaying and eviscerating cows dead of murrain. Three of the cases were males.

In Europe, malignant pustule has hitherto been chiefly observed on the continent, particularly in France, Holland, Switzerland, and Germany. The inhabitants of Great Britain appear to be nearly exempt from it; at least we may so infer from the fact that hardly any allusion is made to the disease in any of their works. In France it is said to be very common in Lorraine, Franche-Comté, Burgundy, Provence, Lyonnais, and some of the other southern regions, although no part is wholly exempt from it. It appears to be rare at Paris, but frequent at Marseilles, showing that locality is favorable to its production.

The disease is most common upon the hands and face, because these parts, being habitually exposed, are most liable to inoculation. Persons who work among hides, both green and dry, tanners, butchers, shepherds, blacksmiths, and veterinary surgeons, are most liable to its attacks. It is often contracted by common people in flaying and eviscerating animals dead of murrain. It has also occurred from introducing the hand into the rectum and vagina of a cow laboring under putrid fever. Cases have been observed where the virus was conveyed by insects from the diseased brute to man. I have already alluded to the fact that it may be communicated by the green carrion-fly. It would seem that certain parts of an animal, as the hair and wool, retain the poisonous matter for a long time, and even after they have been most thoroughly washed and cleansed. Dr. Bourgeois refers to the case of a man in which the disease was apparently produced by picking the horse-hair taken out of an old sofa. A very common way in which it is contracted is by handling dry hides. Even tanned leather is said to be capable of communicating the affection. It has been conjectured that it might be contracted by eating the flesh of brutes dead of murrain, but we know of no facts that justify such a conclusion. Whether it can be conveyed from one human being to another, or from man to the inferior animals, is also undetermined.

What the nature of the *poison* is which produces this disease, or when, where, and how it is developed, is a question which we have no means of solving. It is evidently of a zymotic character, like the virus of smallpox and chancre, and is generated by most of our domestic animals, especially cattle dead of murrain, its occurrence being less frequent in the horse, mule, ass, and sheep. It is also probable that it may be generated by birds, as the hen and turkey. In a case which occurred a number of years ago in Kentucky, and of which I have collected the particulars, the disease was contracted by three persons in picking and eviscerating several buzzards with a view of extracting their oil. Both the hands and forearms of each individual were inoculated. Violent local and constitutional symptoms showed themselves by the end of the second day after the operation, the parts becoming excessively swollen and painful, and covered with numerous vesicles, which, upon bursting, exposed ill-looking ulcers, discharging a thin sanious fluid, and remaining open for many weeks. The inflammation reached up to the axilla, the glands of which were enormously enlarged, some of them finally suppurating. Recovery took place only after a long time, and after great suffering, reducing the patients to the very verge of the grave. It is difficult to say whether, in these cases, the poison was actually generated by these birds, or merely conveyed by them through their feathers. However this may be, the facts involved in them are of much interest.

Symptoms.—The period of latency of the disease is very brief, generally, perhaps, not exceeding a few hours. The first distinguishable evidence of the operation of the poison is a small reddish point, not larger than a pin's head, and the seat of a burning, itching sensation, attended with a desire to scratch. Gradually spreading in size, it is speedily followed by a little vesicle, filled with a thin, turbid serum, which, in its turn, is soon replaced by a pustule of a yellowish, brownish, or reddish color, according as it contains pure pus, or pus mixed with blood. Around the pustule is a distinct areola, not unlike that of smallpox; the part is exquisitely painful, hard, and circumscribed, allowing itself to be raised up from the subjacent structures. Continuing to extend, it becomes gradually more and more prominent, and at length acquires a base equal to the diameter of a twenty-five cent piece, half a dollar, or even a dollar. Meanwhile the pustule bursts, revealing a foul, gangrenous ulcer, discharging a sanious, fetid, irritating fluid, sometimes quite abundant. Long before the disease has reached this crisis, the affected limb is enormously swollen, stiff, numb, heavy, and exquisitely painful, the inflammation often reaching as far as the shoulder, and seriously involving the axillary glands. The number of vesicles is variable; in one of my cases there was only a single one; in another there were two, one on the hand and the other on the forearm; in the third there were five; and in a fourth the whole arm and hand were literally covered with them, their number amounting to several hundred. When numerous, they are always proportionably small, not exceeding the diameter of a currant or a split pea.

When the disease is seated in the face, the swelling is generally so great as to give rise to the most hideous distortion, it being almost impossible to distinguish one feature from another. The eyelids are closed and distended like bladders, the lips are several times the natural thickness and hardly movable, the cheeks are enormously puffed out, and the natural line of demarcation between the jaw and neck is completely effaced. The face, in fact, looks more like a dark, shapeless mass than a human countenance. When seated here, the malady is apt to extend to the throat, causing great swelling of the palate and tonsils, attended with immense difficulty of deglutition and respiration, and sometimes followed by suffocation.

The constitutional symptoms are those, in the first instance, of general *malaise*, or uneasiness, with a feeling of depression and foreboding of evil. Presently high fever sets in, preceded and accompanied by rigors; and then, in a very few days, the patient sinks into a low typhoid condition, commonly attended with low muttering delirium, loss of sleep, and excessive restlessness. Death often follows in three or four days from the first manifestation of the disease; but sometimes it does not take place under a week, and in a few rare cases not before the end of a fortnight. The patient's habits and state of health at the time of the inoculation, the quantity of matter absorbed into the system, and the nature of the treatment, all, doubtless, exercise an important influence upon the issue of the case. As a general rule, however, it may be stated that few recoveries occur under any circumstances.

Dissection has hitherto thrown no light upon the nature of this disease. The internal organs, especially the lungs, are generally considerably engorged; and in a few rare instances metastatic abscesses have been found. The affected limb is usually distended with serum and lymph, the latter of which often exists in large quantity, giving the parts their characteristic hardness, and exhibiting occasionally, here and there, a greenish, gelatinous appearance. In one case I discovered several depôts of blood. If the patient survive sufficiently long, abscesses will be found in the subcutaneous cellular tissue, or evidences of purulent extravasation. The inflammation seldom extends deeply among the muscles, being apparently limited by the aponeuroses. The axillary glands are sometimes much enlarged, softened, discolored, and infiltrated with various kinds of fluids. In the immediate neighborhood of the vesicles the parts are of extreme density, cutting with a grating noise very much like fibro-cartilage. Doubtless the veins and absorbents are implicated in the disease, but in what manner, or degree, has not been ascertained. There is usually, after death, a tendency to rapid decomposition.

Treatment.—The treatment is prophylactic and curative. As soon as it is ascertained that an individual has been inoculated, the part should be immediately cut out, after which it should be well washed with warm water, to encourage vascular disgorgement, and then still further drained by the cupping-glass, these means being followed by thorough cauterization with dilute acid nitrate of mercury or the solid nitrate of silver. Or, instead of this, the part is destroyed with the Vienna paste, or the hot iron. When early and effectual riddance has been neglected, or found impracticable, the treatment must be conducted upon general principles, by mild, soothing, and supporting measures. All sanguineous depletion, both by the lancet and leeches, active purgation, and other debilitating means are avoided, as calculated, inevitably, to hasten the fatal crisis. The secretions, always seriously deranged in this disease, are rectified by small doses of calomel, the excessive pain is allayed by full doses of morphia, and the system is sustained by the liberal use of brandy, quinine, and other stimulants. The limb, placed in an elevated position, is wrapped up in light flannel cloths, wrung out of a tepid solution of lead and opium, and if there be much tension and throbbing, early and free incisions are practised to afford vent to the effused fluids. Sometimes great comfort is experienced from the employment of an emollient cataplasm, covered with laudanum and olive oil. Fetor is allayed by the chlorides, which may also sometimes be advantageously given internally. Should convalescence take place, the cure must be promoted by nutritious drink and food, and change of air.

CHAPTER X.

EFFECTS OF INJURIES UPON THE NERVOUS SYSTEM.

Under this head may be included the more immediate effects of injuries, as nervous depression, or shock, and traumatic delirium, as it has not inaptly been termed. These effects may succeed to almost any lesion, however trivial or complicated, their production being greatly influenced by the temperament, habits, age, and idiosyncrasy of the individual; and they deserve the most careful study, inasmuch as they are frequently followed by the worst consequences. The subject of tetanus might properly be included under the present division, but as this disease occasionally arises without any external injury, the consideration of it will be postponed until I come to speak of the affections of the nerves.

SECT. I.—PROSTRATION, COLLAPSE, OR SHOCK.

Shock may be defined to be a depression of the vital powers, induced suddenly by external injury, and essentially dependent upon a loss of innervation. It bears, in effect, the same relation to the nervous system that syncope does to the vascular; in the one case, the result is caused by a diminution of nervous fluid, in the other by a diminution of blood; in both, the consequence is more or less prostration, with perturbation of body and mind, extremely variable both as to intensity and duration. When nervous shock is severe, it may instantaneously terminate in death, as so often happens in falls and blows upon the head; more generally, however, after having continued for an indefinite period, it passes into reaction, the powers of life gradually coming up, as the different organs and the general system regain their nervous fluid. The most severe and fatal cases of shock are generally those that supervene upon direct injury to the great nervous centres, as the brain and spinal cord; no less disastrous effects occasionally succeed blows upon the epigastric region, in consequence of the violence thus inflicted upon the solar plexus of nerves. In some of these and other similar instances life is destroyed with the same rapidity as by lightning, the nervous fluid being instantaneously annihilated without the individual being rendered conscious of his doom. Such cases have their counterparts only in those frightful hemorrhages in which, a large artery, as, for example, the aorta, being divided, the patient perishes in a few seconds from loss of blood. The blood has long been known by physiologists as the vital fluid, so necessary has its integrity always been regarded to the well-being of the system and the maintenance of healthy action. But it is certainly not the only fluid entitled to this distinction; the nervous fluid is both more subtle and more important as a life preserver. When blood flows away in a mighty and overwhelming torrent, the person dies, and life is then said to be destroyed, as it certainly is, by the excessive sanguineous drainage. But in shock, the same effect may happen, and yet the body be literally surcharged with blood, not a single drop perhaps having been spilled in the accident causing the fatal result. Thus, of the two fluids, the nervous is, in every respect, the more important, because the more essential to life; and its disturbance is therefore a more frequent cause of death.

It would be out of place in a work on surgery to inquire into the nature of the nervous fluid, or to attempt to settle the question, so often propounded, whether there really is any fluid of this kind at all. Such an investigation belongs more properly to physiology; but there is no sensible practitioner who has not occasion daily to lament, in the exercise of his profession, his want of knowledge of the functions of the nervous system, and I feel sure that cases of disease and accident are constantly permitted to slip through our hands simply because of our forgetfulness that there is such a thing as a nervous fluid. No one is unmindful that a patient has blood, that a certain quantity of this fluid is necessary to the maintenance of health and life, and that, like the solids, it is subject to a thousand diseases, often of themselves sufficient to cause death. Unfortunately, we can never acquire any intimate knowledge of an agent so subtle as the nervous fluid; like the electric, or galvanic, which it is supposed to resemble, we can know it only by its effects.

Shock may be produced by a great variety of *causes*, some of a bodily, others of a mental character; some external, others internal. It may be purely nervous, or partly nervous and partly hemorrhagic, that is, dependent upon the conjoined loss of the nervous and sanguineous fluids. The nature and extent of shock are greatly influenced by the state of the general health at the time of the accident, the amount of the injury, the importance of the part more directly assailed, and, also, in an especial manner, by the idiosyncrasy of the individual. There are some persons, soldiers, for example, of the most undoubted courage, men who would not hesitate to face the mouth of the cannon, who fall into a state of the most profound prostration from the most trifling accident; who turn pale and tremble like a leaf; whose minds are perfectly bewildered, and who are, as it were, completely stunned, from injuries so insignificant as not to affect, in the slightest degree, ordinary persons. Such an occurrence can only be explained by a reference to idiosyncrasy; and it has its counterpart in those persons who, although extremely plethoric, faint from the slightest loss of blood, or even from the mere sight of that fluid. There are other persons, on the contrary, whom hardly any accident, however severe, can shock; they are insensible to pain; their nervous system is obtuse; nothing affects them, either bodily or mentally; a severe blow may stun them, but the effect is transient; in a few minutes they are completely restored to consciousness and power. Here, again, is an example of idiosyncrasy, a peculiarity of organization; in the former case, the individual is all nerve, all sensibility; in the latter, all blood, all muscle. But it is not only the nervous and irritable that suffer from shock; the fat and corpulent are prone to be affected by it from the slightest causes, and hence such persons seldom make good subjects for the knife; they bear the loss of blood badly, and are extremely liable to perish from erysipelas and pyemia, in consequence, as it appears to me, rather of loss of nervous fluid than from any toxic state of the blood, or blood-poisoning, properly so-called. There are some individuals whom the slightest operation will kill; touch them, and they are sure to die; they are destitute of life-power, and incapable of resisting the slightest shock. The fainting produced by the pricking of a needle and the introduction of a bougie affords a familiar illustration of shock from trivial causes.

Among the external causes of shock deserving of particular notice, on account of their crushing effects, are injuries upon the skull and spine, such as are produced by a fall or blow; gunshot, railway, steamboat, and factory wounds; dislocations and fractures; violent sprains, burns, and scalds; and some of the more severe operations, as the extirpation of enormous tumors, and the amputation of the larger limbs, even when not attended with any considerable hemorrhage.

Severe shock is frequently produced by internal causes. One of the most familiar examples of this kind is afforded in perforation of the bowel, consequent upon typhoid fever, and followed by extravasation of fecal matter. The moment this takes place, the shock is immense; if the patient had been struck severely on the head, it could not be more so; in some cases it is so overwhelming as to destroy life in a few hours. The pain which attends the passage of a gall-stone, or of a urinary concretion, is often followed by similar results; extravasation of urine may be mentioned as another example. Many a woman has perished from shock induced by severe labor; and the excessive prostration consequent upon apoplectic seizures is familiar to every practitioner.

Mental shock is often extremely severe, and is occasionally followed by the worst consequences, especially when it occurs during the progress of a severe illness, or after a severe surgical operation. Fright is perhaps the worst of the causes of mental shock. The effect of terror, in suddenly exhausting the nervous power, is well illustrated by the history of those persons, who, being sentenced to be bled to death, actually died on hearing water trickling into the basin, which they supposed to be blood issuing from their veins, after the arm had been slightly pricked, although no vessel had been opened. It is related of Desault that he one day lost a patient, about to be lithotomized, from sheer fright. The man, who was very cowardly, fainted and died under the impression that the operation was progressing, when this distinguished surgeon was, in fact, only tracing the line of the intended incision on the perineum with his nail. A sick, bedridden person, in danger of being burnt to death, has been known to perish from shock, brought on by excessive mental trepidation. The receipt of disagreeable news, the sudden loss of property, and, in short, violent mental emotion of almost any kind, may give rise to similar effects.

Mental and corporeal shock are often combined; and, when this is the case, it is not uncommon to see the former predominate, in a very marked degree, over the latter. The soldier on the field of battle may suffer from bodily shock induced by a severe wound; he may feel that he is badly hurt, but still he is sanguine of recovery, and cheerfully and manfully bears up under his affliction. The surgeon examines his wound, and perceiving its grave character, informs him that it will probably cost him his life. Instantly the case assumes a different aspect; the system is overwhelmed with perturbation and excitement; the vital powers are depressed to the utmost; and death takes place perhaps several days sooner than it would otherwise have done.

The *symptoms* of shock, although extremely variable, are generally such as attend syncope from loss of blood, or concussion of the brain, which is itself only a form of nervous depression, or expenditure of the vital forces. If the accident has been slight, the effect will be that of a moderate stun, that is, the patient will experience some degree of mental confusion, look pale, and feel weak and tremulous; objects will appear dark to him, and he will probably reel, if not fall. Presently, however, especially if he lies down, reaction will take place, and in a short time he will recover both his mental and physical powers, so as to be able to converse, act, and walk in the same manner as before he was hurt. When the injury has been severe, the effect upon the nervous system will of course be proportionably greater. The patient, unable to support himself, falls to the ground, often as he does so inflicting serious violence upon his person. Consciousness, special sensation, and volition are perhaps completely abolished; the countenance is deadly pale, the respiration is slow and feeble; the pulse is small, fluttering, and, at times, altogether imperceptible; the extremities become rapidly cold: and the surface is soon bathed with an abundant clammy sweat. Gasping and sighing, with convulsive tremors, are often present, and, in general, but too clearly denote the serious character of the lesion. Not unfrequently there are involuntary discharges from the bowels, with nausea and even vomiting.

The duration of these symptoms is subject to no little diversity; at times they pass off in a few minutes, or, at farthest, in a few hours; at other times, they last for several days, and even then perhaps they do not disappear entirely, one or more hanging on for a considerably longer period. When the shock is very severe, death may occur instantaneously, or the case may linger on for some time in a state of doubt and uncertainty, with, now and then, an attempt at reaction, and at last prove fatal. Instances occasionally occur in which, after tolerably complete reaction has been established, the system sinks again into a partial state of collapse, the vital forces having evidently not sufficient stamina to maintain the action of the brain and heart. Such cases are very apt to end fatally, generally within the first twenty-four hours after their commencement.

Reaction, after shock, is denoted by a gradual, or more or less rapid resumption of the functions of the different organs, which awake, so to speak, from their slumber, and spring back again into life and happiness. One of the first evidences of this change is a return of the color of the face, with an increase of the heart's action, as indicated by the state of the pulse, which is not only stronger and fuller, but more steady and regular; the respiration is more free and open; the surface becomes warmer and dryer; the sphincters again obey the will; and the mind regains its self-possession and power of action. Often the first symptom of reaction, after severe shock, is vomiting, followed by complete clearance of the contents of the stomach, itself generally a favorable sign, as it is denotive of a return of muscular power.

There is a form of shock which has been called, not inaptly, insidious, as the symptoms are generally of a masked character, and are therefore well calculated to deceive both the patient and practitioner. The person, although severely injured, congratulates himself upon having made an excellent escape, and flatters himself that he is not only in no danger, but that he will soon be well: in fact, to look at him one would hardly suppose, at first sight, that there was anything serious the matter with him; the countenance appears well, the breathing is good, the pulse is but little affected, except that it is too soft and frequent, and the mind, calm and collected, possesses its wonted vigor, the patient asking and answering questions very much as in health. But a more careful examination soon serves to show that deep mischief is lurking in the system; that the machinery of life has been rudely unhinged, and the whole system profoundly shocked; in a word, that the nervous fluid has been exhausted, and that there is not enough power in the constitution to reproduce and maintain it. The skin of such persons soon assumes an icterode, or sallow, cadaverous appearance, feeling at the same time doughy and inelastic; the extremities become deadly cold; the pulse makes a desperate effort at seeming excellence, but is, at best, weak and tremulous; there is little or no pain; and the patient is altogether too composed and tranquil for the amount of injury he has sustained. The system does not seem to be conscious of what has occurred; its sensibilities are blunted, and hence it is incapable of suffering. Nature, to use the language of Hunter, does not feel the injury.

The countenance, in this form of shock, has often a peculiar melancholy expression, as if foreshadowing the fatal event; a sad smile plays upon the lip, and illumines the lower part of the face, while the upper part, on the contrary, wears a gloomy aspect, in striking contrast with the other. The forehead, as the patient looks at his attendants, especially if he has just been roused from sleep, is strongly knit and wrinkled, giving it a scowling and sinister air. As the case progresses, the brain gradually sinks into a comatose condition, the signs of prostration become more pronounced, and death finally occurs from mere exhaustion, life, under such circumstances, seldom lasting longer than three or four days.

The *treatment* of shock must be conducted with two objects in view; the first is to promote reaction, and the second to moderate supervening inflammation, for to prevent it altogether is by no means always possible.

To recover a patient from shock, he should immediately be placed recumbently, everything tight or constricting should be removed from his person, free access of cold air should be provided, cold water should be dashed upon the face, smelling bottles should be held near the nose, and sinapisms should be applied to the extremities and precordial region. If the case be unusually severe, and apprehension is entertained for the patient's safety, stimulating injections should be thrown into the rectum, and turpentine rubbed along the spine. If deglutition is practicable, brandy and water should be given, but in attempting to convey this or any other fluid into the stomach, great care must be taken, otherwise the liquid may descend into the windpipe, and so cause strangulation. The most prudent plan, under such circumstances, is to introduce the drink with a spoon, the mouth being previously forced wide open, and a powerful effort made to excite the patient's attention by hallooing loudly into one of his ears. If he cannot swallow, no attempt should be made at compulsion, but, for the reasons just mentioned, the effort should at once be discontinued.

In the milder cases of shock, the most simple treatment will often suffice to bring about reaction; as, for example, the recumbent posture, a drink of cold water, and the use of the fan and smelling bottle. The blood and nervous fluid soon resume their wonted channels, and the vital forces rapidly regain their supremacy.

In the mental form of shock, a soothing word, or an assurance of absence of danger, will frequently go farther in promptly effecting restoration than the most powerful stimulants, steadily and regularly administered. Persons suffering from this variety of prostration are frequently much more frightened than hurt, and promptly regain their animation and self-possession when they are told that their injuries are altogether of a simple, trivial character, devoid of all danger, both present and future.

Occasionally reaction is sadly interfered with by an overloaded and oppressed stomach, as when the accident has occurred soon after a meal. In such cases, the patient often lies in a state of deadly pallor, with more or less retching, for hours, before he can shake off the oppressive burden. The indication obviously is to assist nature in her efforts at emesis, by the administration of a dose of alum, ipecacuanha, or sulphate of zinc, or, what, perhaps, is better, under such circumstances, equal parts of common salt and mustard. Serious lesion of the brain is hardly to be considered as a contra-indication to such a course, when it is recollected that the digestive powers are completely suspended, and with what difficulty reaction takes place when the stomach is oppressed by a heavy meal.

The foolish and reprehensible practice of bleeding persons laboring under the exhaustion of shock, once so common, has become completely obsolete. No surgeon should do anything without a reason, and it is therefore difficult to perceive what could ever have induced a procedure so contrary both to physiology and good sense. In the opinion of the vulgar, there are no cases in which it is not proper, immediately after such an accident, to draw blood from the arm; but assuredly no practitioner would yield his judgment to such an erroneous view, and perform an operation that might speedily prove destructive to his patient. Fortunately, whenever such an attempt is made by the ignorant and thoughtless charlatan, the blood generally refuses to flow, and consequently no harm is done.

The second indication is to moderate the resulting inflammation. To do this, much may be accomplished in the way of prevention, by letting on the reaction gradually; avoiding, on the one hand, the undue use of stimulants, and, on the other, cautiously interposing antiphlogistics as occasion may arise for their exhibition. Proper allowance is made for the apparent violence of the symptoms, the excitement without power; the struggle may be furious, but will in all likelihood be brief, for if the previous depression has been at all severe the flame will ere long cease of its own accord, or readily yield to the influence of very simple means, such, for instance, as sponging the surface frequently with cool or tepid water, and administering a little morphine and antimony, aided by rigid abstinence, and perfect tranquillity of mind and body. Bleeding should be practised only in young and plethoric subjects, with a tendency to serious inflammation of some important internal organ, and where, consequently, the fire is real, and not merely apparent. The opposite course often exerts a most pernicious influence upon the patient's recovery; impairing his vital powers, and preventing the system from keeping up a due supply of healthy nervous fluid, so conducive to the restoration both of the part and system. As the secretions are commonly materially deranged in all cases of severe shock, early and effectual means should be adopted for their correction and improvement; a gentle mercurial purge will often admirably fulfil the indication, and render any further use of this class of remedies unnecessary. The diet for the first few days should consist mainly of animal broths, aided, if necessary, by milk punch, or wine whey, and cautiously followed by food of a solid and more substantial character. Starvation, in cases of severe shock, is not to be thought of. Such a course cannot be too pointedly or too forcibly condemned, as it is contrary alike to sound sense and the dictates of an enlightened experience.

Anodynes are always borne well after severe shock, and should be administered early and freely, to allay vascular action and tranquillize the nervous system. The most suitable article will be morphine, or the ammoniated tincture of opium, either alone, or conjoined with valerian; the latter remedy being especially serviceable in nervous, hysterical persons. If the vital powers flag sensibly after the occurrence of reaction, recourse must be had, in addition to anodynes, to quinine, carbonate of ammonia, and brandy, liberally and diligently administered. Determination to internal organs is met by leeches and blisters.

SECT. II.—TRAUMATIC DELIRIUM.

One of the most unpleasant effects with which the surgeon has to contend in the treatment of wounds and other injuries, as well as after surgical operations, is the occurrence of delirium, at a period, too, perhaps, when everything is apparently progressing in the most favorable and gratifying manner. All of a sudden, the nature of the case undergoes a remarkable change for the worse; the horizon, just a moment before perfectly calm and serene, like the summer's sky, is almost instantly overcast by a dark, lowering cloud; the system is thrown into nervous tremors, and the mind, agitated with disagreeable forebodings, is absorbed in some peculiar fancy, in which the patient imagines himself pursued by his enemies, or annoyed by persons peeping at him through the keyhole of his door, making grimaces at him through the window, or concerting measures for his destruction. Great diversity obtains in respect to the manner in which the disease is ushered in.

In some cases the symptoms are apparently of a hysterical character, the patient laughing and talking in a loud, boisterous, and incoherent manner; or perhaps indulging in unmeaning jokes about the nature of his disease, the way in which he was hurt, or the conduct which he exhibited during the operation he has undergone. In another class of cases, by no means uncommon, he is completely absorbed in his business; he harnesses his horses, hitches them to the carriage, and swears at them because they do not move to please him. In some cases, again, he is seized with a species of religious phrensy; he prays and sings, and utters pious exclamations. Occasionally, he labors under some demoniacal delusion; he fancies that the devil has possession of him, and that he is about to be carried to the infernal regions. Finally, there are instances in which the patient is sadly annoyed by the idea that he is pursued by snakes, dogs, or rats, or that some horrible reptile is trying to creep into his throat. In short, there is no end to these delusions, which are often as ludicrous to the observer as they are distressing to the patient, to whom they are always a source of severe suffering, not less so than if they were real.

The cause of these symptoms is not always apparent. In the great majority of cases, they are produced, either directly or indirectly, by the inordinate use of alcoholic spirits, suddenly interrupted by the occurrence of a severe injury, attended, it may be, by dreadful shock, or copious hemorrhage, thus greatly increasing the susceptibility of the nervous system to external and internal impressions. It is not necessary for their development that the individual should have been a habitual drunkard; they often show themselves nearly as readily if he has merely been a free drinker without having carried the use of liquor to the extent of intoxication. On the other hand, they occasionally occur in persons of the most temperate habits, who have perhaps never used alcohol in any form, or for any purpose whatever. Dupuytren, who first called attention to this variety of the disease, has given it the name of nervous delirium, and in the paper which he has published on the subject he has reported a number of cases in which it supervened upon various kinds of injuries and operations, some of them of a very trivial character, or such as usually produce no unpleasant results of any description, the patient rapidly recovering from their effects. It cannot be doubted that, in these cases, the affection is generally of a purely nervous nature, arising from the effects of the commotion inflicted upon a delicate and highly susceptible constitution. Under such circumstances, it is often mixed up with the effects of shock, rendering it difficult, if not impossible, to distinguish them accurately from each other. All practical surgeons have frequent opportunities of witnessing such cases. So far as my observation extends, I am not aware that any class of injuries is entirely exempt from the disease; sometimes the most trivial scratch, or contusion, is followed by it. Corpulent persons, who generally bear injuries and operations very badly, are particularly prone to this form of delirium. Burns and scalds, railway lesions, lacerated wounds, and compound fractures may be enumerated as among the more powerful causes of the disease. It has been thought that children are less liable to suffer from nervous delirium than adults and elderly subjects; but this is certainly not true; on the contrary, such is the susceptibility of the system at this tender age to physical and mental impressions, that the slightest accident is often sufficient to develop it. If women are less frequently affected than men, it is simply because they are less exposed to the various exciting causes of the disease. There is certainly every other reason why they should suffer quite as much as men, if indeed not more.

Nervous delirium generally comes on within the first twenty-four or forty-eight hours after the application of the exciting cause; it may last for a variable period, but rarely longer than five or six days, and may terminate either in health, or in death, according to the gravity of the injury that has produced it. Its leading symptoms are a confused, wandering, or flighty state of the mind, with excessive vigilance; incoherency of speech and manner; absence of fever; an open, moist state of the skin; and little or no excitement of the pulse. The eyes have generally a wild expression, and the patient is easily disturbed by noise and light, as well as by the presence of his attendants. The appetite is usually impaired, the bowels are costive, the urine is scanty and rather high-colored, and the feet are disposed to be cold. If the patient be spoken to, he is generally readily roused, but soon lapses into his former condition.

Nervous delirium, properly so called, is easily distinguished from delirium tremens by the absence of tremors, which form such a striking feature in the latter disease as to be characteristic. In delirium tremens the limbs are in a constant trembling condition; the symptom comes on early in the attack, and always lasts until the effects of the disease are nearly worn off. When the delirium is fully developed, the hands and fingers are incessantly in motion, the patient carrying them to his mouth, face, and head, as if he were desirous of swallowing something, or removing some imaginary object from his person. The countenance is usually flushed, the eyes are deeply injected, the pulse is small, frequent, and quick, and the mind is roused with difficulty. Added to these circumstances is the history of the case, which generally affords valuable, if not conclusive, information respecting the patient's habits prior to his attack.

Delirium tremens, the result of alcoholic stimulation, is an extremely common occurrence after all severe operations and injuries, and is one of the most serious causes of their mortality. Hence operations should never, if possible, be performed upon this class of persons so long as they can be put off, or without due preparation of the system; special care should also be taken to avoid shock and loss of blood, as these are two of the most powerful predisposing causes of the disease.

It is well known that persons addicted to the immoderate use of opium and tobacco are liable to suffer from a peculiar form of nervous delirium after severe injuries and operations, characterized by excessive wakefulness, and a sense of indescribable wretchedness, with a bewildered and confused state of the mind, from which it is sometimes extremely difficult to rouse them, so as to induce them to take their necessary food and medicine. It is not improbable that the excessive use of coffee and tea may, in persons of a very nervous, excitable temperament, produce similar effects.

In general, as was previously intimated, traumatic delirium usually sets in at an early period after the application of the external injury that provokes it: sometimes, however, the patient, perhaps contrary to expectation, goes on exceedingly well for some considerable time, happily surmounting the primary effects, but suffering severely from the secondary, the consequence commonly of profuse, unhealthy, and exhausting suppuration. Again, instances occur in which he may have several attacks of this nervous suffering, with a variable interval of from several days to several weeks, during which the mind may be perfectly clear and tranquil, the patient bearing up manfully under his disorders, sanguinely and fully anticipating none other than the most favorable termination.

Traumatic delirium, however induced, or in whatever manner it may present itself, is often extremely difficult of management. In its worst forms, the mind is frequently so completely disordered as to render confinement of the patient with the strait waistcoat an indispensable item of the treatment. This is the more necessary when, as sometimes happens, the patient is disposed to tear off the dressings from his wounds, to commit suicide, or to hurt his neighbors and nurses. There is a remarkable circumstance which has been noticed by all practitioners in this class of persons; I allude to their utter indifference to pain. So great is this, in many instances, that they will not only uncover their wounds, but absolutely take a sort of pleasure in handling and picking them. Dupuytren refers to the case of an old man who, having been operated upon for strangulated hernia, tore away the dressings from his groin, and composedly squeezed his bowels, his friends all the while thinking he was getting on most admirably, such was his calm and quiet demeanor as he lay in bed.

One of the most important indications, then, is to set a careful watch over the patient, in order that he may not do any harm either to himself or others; in wounds and fractures the most perfect quietude is generally necessary, and the greatest pains should therefore be taken to secure it to the fullest extent, for whatever has a tendency to disturb and fret the parts will be sure to act as a cause of additional excitement. Moral force alone will be of no avail; the patient can neither reason correctly himself, nor comprehend the reasoning of those about him. Hence if medicine does not promptly effect the object, the only resource is the strait jacket, applied of course with proper care, so that while, on the one hand, it shall not be so loose as to frustrate the intention of its use, it shall not, on the other, be so tight as to occasion injurious constriction; a circumstance which, although a matter of paramount importance, is not always, as I well know from experience, as scrupulously attended to as it should be by nurses and practitioners.

The next indication is to tranquillize the nervous system, and induce sleep, or, in other words, to get rid of the redundant excitement. To fulfil this indication, recourse must be had to anodynes, administered in such doses as shall most promptly and effectually bring about the desired result. The patient must sleep before he can obtain relief; the early interposition, therefore, of suitable treatment is a matter of primary importance, attacking and routing the disease, as it were, in its very incipiency, ere yet it has taken firm hold of the system. The best remedy will be found to be opium, either in the form of morphia or of the acetated tincture, given in full and sustained doses, in combination with a sufficiency of tartar emetic to prevent vascular excitement and promote perspiration. Solid opium is objectionable, as it takes a long time to dissolve in the stomach, and often excites instead of tranquillizing the nervous system. Tartar emetic will always be found to be a most valuable adjuvant. In the milder cases, the disease frequently promptly yields under the influence of a small quantity of laudanum, as from fifteen to twenty-five drops, in half an ounce of camphor-water and a drachm of the compound tincture of cardamon, repeated every two or three hours. Dupuytren was in the habit of employing laudanum as an injection in this disease, giving from ten to twenty drops with a small quantity of water, and frequently repeating the dose, until he succeeded in accomplishing his purpose. He asserts that the medicine thus administered often exerts a much more prompt and happy effect than when given by the mouth; and the result of my own experience amply corroborates the truth of the statement. As a preliminary measure, the rectum should be well cleared out with an ordinary enema.

When opium and its preparations cannot be borne, an excellent substitute will occasionally be found in hyoscyamus, lupulin, aconite, belladonna, and Indian hemp; aided by the cool shower-bath, followed by dry frictions, or, what will generally answer quite as well, and be more convenient, sponging of the surface freely and repeatedly with tepid, cool, or cold water. When the delirium is furious, leeches should be applied to the temples, or a large blister to the nape of the neck, and cold to the scalp, previously divested of hair. As a temporary expedient, and an auxiliary for allaying the violence of the spasms, the judicious inhalation of chloroform will be of service. General bleeding will rarely be proper in any case, whether of nervous delirium or delirium tremens. In nervous, hysterical females, the free use of assafœtida and of valerianate of ammonia often answers better than almost anything else.

When the patient has been a habitual drunkard, or when the delirium can be distinctly traced to the effects of the sudden withdrawal of alcoholic stimulation, the dictates of common sense, not less than the results of sound experience, indicate the propriety of a resumption of the accustomed drink, or a resort to an appropriate substitute. Much judgment will of course be necessary under such circumstances, lest the remedy be carried too far, causing thereby additional excitement and vigilance instead of composure and refreshing sleep.

CHAPTER XI.

SYPHILIS.

SECT. I.—GENERAL CONSIDERATIONS.

The term syphilis is applied to a class of diseases which, commencing in the genital organs in the form of a sore of a specific character, may, and often do, invade the lymphatic ganglions of the groin, the cutaneous and mucous tissues, and finally also the bones, cartilages, and fibrous membranes, leaving upon each and all of them, as well as upon the system at large, a peculiar and distinctive impress. These different parts, however, do not all suffer at one and the same time; on the contrary, it would seem to be necessary that the poison upon which the infection depends should lie for a certain period in the tissues in which it has been deposited in order to enable it to prepare itself for further action. Thus, in the first instance, the operation of the poison is strictly local, the sphere of its influence being limited to the genital organs, or to these organs and the lymphatic ganglions of the groin. After having lingered here for some time, varying, on an average, from four to six weeks, the cutaneous and mucous surfaces begin to suffer; and at a still later period, that is, from six to eighteen months, the bones, cartilages, and fibrous textures are attacked. In this manner are produced three distinct groups of syphilis, known, respectively, as primary, secondary, and tertiary, depending upon the peculiar modifications of the specific poison to which the malady owes its origin.

It is not my intention here to enter into an account of the history of the origin of syphilis; such an undertaking, besides involving an immense amount of research—ethnological, literary, and biblical—would be entirely out of place in a treatise of this description, limited as it is to the practical details of surgery. I may remark, however, that, in my opinion, it is great folly to regard the disease as of modern origin. If the records of antiquity could be fully explored, it cannot be doubted that we should discover the most satisfactory and irrefragable evidence of the existence of syphilis in the most remote periods of society, now aggravated and now kept in abeyance, according to the habits and morals of the various races of mankind, and the nature of the climate of the countries in which they dwelt. If the history of the inner life of Sodom and Gomorrah could be laid open to our scrutiny, it would furnish a page to the history of prostitution as loathsome and disgusting as any afforded by the vilest and most depraved cities of the present day, either in the Old World or in the New.

Syphilis is peculiar to man. Numerous experiments have been performed, by inoculation, upon almost all the domesticated animals, but in no instance whatever has the poison produced any specific effect. The little puncture made with the lancet in the operation became temporarily inflamed, but the impression soon passed off, and the parts rapidly recovered their natural condition. If, in the monkey, the inoculated surface assumed somewhat more of the appearance of a chancre than in the other classes of animals

This book is the p.
COOPER MEDICAL C
SAN FRANCISCO, CAL.

subjected to trial, it was, nevertheless, not characteristic, and it is certain that no case has ever been reported where the insertion of the matter was followed by constitutional symptoms.

The disease never arises spontaneously, but is always the result of inoculation with a peculiar *poison*, known as the poison of syphilis or of chancre. Of the precise nature of this poison we have no knowledge; we only know it by its properties, or by the effects which it is capable of exerting upon the economy when brought in contact with it under circumstances favorable to its development. Thus, observation and experiment have shown that it always produces a disease similar to itself, the resulting sore or ulcer yielding a virus, in every respect identical with that which furnished it in the first instance. Like the poison of smallpox, it is a peculiar poison, capable of reproducing itself, and of multiplying itself by zymosis. The smallest, inconceivable atom, brought in contact with an appropriate surface, will speedily develop a disease which, if permitted to progress, may occasion the most horrible consequences, both local and constitutional, and so contaminate the solids and fluids as to render it transmissible from the parent to the offspring. As a little yeast may impregnate a large mass of dough, and cause a ferment that shall affect every particle of gluten entering into its composition, so a little syphilitic virus, so minute as to be utterly inappreciable by our senses, may affect the whole system, and poison every avenue of life and health. Zymosis having fairly commenced, it is impossible, in any case, unless proper means be adopted to counteract it, to say when it may cease, or what may be its ultimate effects.

The pus which contains the syphilitic virus, and which therefore serves as a vehicle for its propagation, does not, so far as can be ascertained, differ from pus supplied by ordinary inflammation, either in its physical, chemical, or microscopical characters. Thus, it may be thick and yellowish, serous, ichorous, or plastic; bland or acrid; acid, alkaline, or neutral; pure, or mixed with adventitious matter; and, lastly, perhaps even animalcular, although this point is not fully settled. The specific property of the virus is not destroyed for a number of weeks, if the pus with which it is combined is preserved in a well-corked vial; resembling, in this respect, the virus of vaccinia and variola. It is rendered inert, however, by chemical agents and also by gangrene of the tissues which have been inoculated with it.

The infecting virus does not seem to have any particular predilection for age, sex, temperament, or occupation; all are alike liable to be affected by it. Previous disease does not prevent its action. It produces its peculiar impression most readily when applied to a clean ulcerated surface, an abrasion, or a recent wound; but inoculation may take place independently of these circumstances, simply from the introduction of the virus into a mucous follicle, which thus serves to entangle and retain it until its structure is brought thoroughly under its influence. When the part to which the virus is applied is perfectly healthy, several days may elapse before it becomes impregnated; or it may even escape entirely, the matter which contains it either not being able to penetrate its surface, or being wiped off before the occurrence of absorption. For the same reason a person thus situated may communicate the poison to another so as to give rise to a chancre, while he himself experiences no ill effects. Such a result not unfrequently happens in women, in consequence of the matter of syphilis lodging in the folds of the mucous membrane of the vagina, from which it is afterwards transferred to the virile organ in the act of copulation.

The syphilitic virus may be communicated in various ways; first, by sexual intercourse, which is by far the most common; secondly, by unnatural connection, giving rise to chancres of the anus and perineum; thirdly, by the body and bedclothes of the person; fourthly, by surgical instruments and dressings; fifthly, by chamber-pots and water-closets; and sixthly, by the fingers of the affected individual. In this manner a patient may inoculate his lips, nose, eyelids, or any abraded, raw, or open surface upon any portion of the body. In this way, too, accoucheurs sometimes inoculate their fingers in examining women laboring under chancre of the vulva, vagina, or uterus.

It is still a mooted point whether the virus of syphilis begins to act the moment it comes in contact with the living tissues, or whether, after having been absorbed by them, it remains there in a state of latency, as is supposed by some to be the case in inoculation in hydrophobia. Without attempting to decide this question, for which our data are perhaps still insufficient, it is reasonable to infer that the effects vary, in different cases and under different circumstances, according to the structure of the inoculated surface, the natural susceptibility of the part, the purity and quantity of the poison, and the degree of the resulting inflammation. It is well known that a tolerably distinct chancre is sometimes formed within the first twenty-four hours after an impure connection, whereas at other times this result does not follow under a week. The average period may be stated at from three to six days. My opinion is that the actual latency of the virus is very short, and that, like other zymotic poisons, it begins to act, although imperceptibly to us, within a very brief space after it has been inserted. The probability of this conclusion is strengthened by what occurs in artificial inoculation, an operation which is usually performed upon the skin of the inner surface of the thigh.

SECT. II.—PRIMARY SYPHILIS.

Primary syphilis consists, as already stated, of chancre and bubo: that is, of an ulcer of the genital organs, and of a swelling of the lymphatic ganglions of the groin, often eventuating in suppuration and other bad effects. So long as the disease is limited to these structures it is strictly of a local character; but when it passes beyond them, so as to affect the system, it becomes constitutional.

1. CHANCRE.

If a small quantity of matter be taken from the surface of an ulcerating chancre, and inserted with the point of a lancet into the substance of the skin, just beneath the epidermis, the earliest effect, manifesting itself within the first twenty-four hours, will be a little reddish speck, looking very much like a flea-bite, and denotive of very slight inflammation, such, for example, as might be supposed to result from any little puncture independently of the operation of any specific virus. During the next twenty-four hours, the part exhibits the appearance of a minute papula, or little swelling, somewhat elevated above the surrounding level, and encircled by a faint, narrow, rose-colored areola. From the third day to the fourth the papula assumes the form of a vesicle, the epidermis being raised by a drop of whitish, pearl-colored serosity; the inflammation is more considerable, and the areola is of larger size and of a deeper hue. At the end of this period the vesicle is transformed into a pustule; that is, the inoculated part becomes filled with pus, its centre is gradually depressed, and the areola acquires its most distinctive features. From the fifth to the sixth day the structures immediately around the seat of the disease undergo a remarkable change; hitherto they had been quite soft, or, at most, only somewhat œdematous, but now they are observed to become indurated from the deposition of plastic matter, and to feel, when pressed between the thumb and finger, like a mass of fibro-cartilage, or tolerably firm cheese, the sensation partaking at the same time of an elastic character. Having assumed this character, the sore is possessed of the requisite properties for supplying infecting matter, of which, up to this moment, it was destitute. At the expiration of the sixth day, the pustule begins to turn dark, its contents solidify, and a firm, thick scab forms, composed of several strata, and having the shape of a truncated cone, with a depressed apex. Should the scab now fall off, or be accidentally removed, a large, deep ulcer will be exposed, having an excavated appearance, as if it had been scooped out with a punch, its edges being steep and slightly ragged, its bottom incrusted with a layer of grayish, aplastic lymph, and its base hard, firm, and slightly elastic like fibro-cartilage. The discharge is generally of a thin, sanious, or ichorous nature, without any of the properties whatever of laudable or healthy pus. The ulcer thus formed constitutes what is termed an indurated chancre, or, from the faculty it possesses of contaminating the system, the infecting chancre. It is also not unfrequently called the Hunterian chancre, from the fact that it was first accurately described by Mr. John Hunter in his treatise on the venereal disease. From what has been said, it will be perceived that, although the poison doubtless begins to act at an early period after inoculation, yet it requires some time before it can produce a true syphilitic sore, and that the local disease itself consists of several well-marked stages, running, however, gradually into each other; the first distinct evidence of its presence being a papula, the second a vesicle, and the third a pustule, followed by a hardened base and an excavated ulcer, bathed with infecting matter, which is capable of contaminating the constitution, fluids as well as solids.

Although a chancre may occur on any part of the body, yet as it is by far most common on the genital organs, it is here that it has been studied with the greatest care and attention. Its most common sites are the head of the penis and prepuce, the vulva, vagina, and uterus. The disease may also attack the urethra in both sexes, especially in the male, although the occurrence is very uncommon. Any portion of the head and foreskin of the penis may be affected, but of the former the corona, or rather, the gutter just behind the corona, and the surface on each side of the frenum are most liable to be involved, from the circumstance that these parts are particularly apt to retain the infecting matter; for the same reason the free extremity of the prepuce is very prone to suffer. A severe chancre occasionally forms on the body or root of the penis. In the female the disease sometimes occurs on the perineum, on the outer surface of the labium, and around the anus.

A chancre upon the mucous surface of the genital organs does not always pass through the same regular stages as a chancre upon the skin from artificial inoculation. On the contrary, it frequently begins as an ulcer, in consequence of the matter having been brought in direct contact with an abraded surface, or a scratch, and in this case the evolution of the disease is always peculiarly rapid and well-marked. At other times, again, it commences as a boil or an abscess. This form is most common when the inoculation has taken place from the matter having insinuated itself into the orifice of a mucous follicle. Under such circumstances, the gland swells and becomes softened, and is soon after destroyed by ulcerative action. Moreover, it is important to remember that the vesicular and pustular stages above described may have passed by unnoticed, and that, consequently, when the sore is first inspected, it may possess all the characters of a well-defined chancre. No general symptoms precede or usher in the local disease, whatever may be the form in which it begins; all that the patient experiences is a slight sensation of heat, some itching, and an increase of the sensibility of the part which is about to become the seat of the infection.

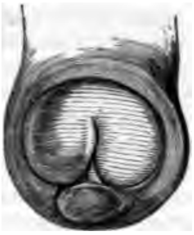
Chancre presents itself under two *varieties* of form, the indurated and the non-indurated or soft, all other distinctions being now abandoned, on the ground that, whatever differences of appearance the sore may exhibit, they are solely and entirely of an accidental character, and therefore altogether independent of the nature of the syphilitic virus. It is impossible, in the actual state of the science, to determine why one person should have a hard chancre and another a soft chancre. In the adjudication of such a question it will not do to invoke the existence of a corresponding number of poisons; to do so would be to destroy the unity of the disease, and to invest the subject with inextricable confusion. The most philosophical course, in the absence of facts, is to assume that there is really only one virus, but that this virus is capable of being so modified in its character, by local and constitutional causes, or by internal and extrinsic circumstances, as to produce effects apparently the very opposite of each other in different individuals. How else can we explain the occurrence of indurated and non-indurated sores upon the genital organs? The laws of disease have their irregularities and anomalies not less than the laws of health; exceptions meet us everywhere, and it would indeed be very singular if they should be altogether wanting in syphilitic affections. In the production of the two varieties of chancre here alluded to, some powerful modifying circumstances must be in operation, shaping, influencing, and controlling the result. Smallpox, scarlatina, measles, and other eruptive diseases are subject to remarkable departures from the natural standard, and yet no sensible pathologist would for an instant suppose that every new feature exhibited by these affections was indicative of the existence of a new poison. The modifying cause, whatever it be, may exist in the inoculated structures, in the peculiar nature of the pus containing the specific virus, in the specific virus itself, or in the state of the constitution, or in all these circumstances combined.

M. Ricord has recently published some very singular statements in regard to the peculiarities of these two varieties of chancre, which, if they shall be ultimately verified by the observation of others, would almost necessarily lead to the conclusion of the existence of two separate and distinct varieties of syphilitic poison. Thus, he positively affirms, on the strength of a large clinical experience, that the indurated ulcer alone is an infecting ulcer, that is, a chancre capable of furnishing a fluid which, if conveyed into the system, may contaminate the solids and fluids in such a manner, and to such an extent, as to give rise to secondary and tertiary accidents. The non-indurated chancre, on the contrary, he regards as a purely local affection, often troublesome, it is true, but always free from the risk of invading the constitution in anywise whatever. My observations would lead me to infer that, while there really are two varieties of chancre, the indurated and the soft, as described by the French syphilographer, they do not by any means possess the properties which he ascribes to them. The hard chancre is unquestionably most frequently followed by constitutional symptoms, but to maintain that it is so exclusively is what, I am sure, no experienced practitioner will admit. So far from giving my adhesion to such a doctrine, I have had the most unequivocal evidence, in numerous instances, of the infecting properties of the soft chancre. Indeed, I am satisfied that some of the very worst cases of secondary and tertiary syphilis that I have ever been called upon to treat have been cases of this description; originating generally in very small sores upon the head of the penis or prepuce, perfectly soft in their consistence, very superficial, manifesting no disposition to spread, and soon completely disappearing. Such chancres not unfrequently exist without the knowledge of the patient, their discovery being, perhaps, purely accidental. It is doubtless this form of ulcer which has given rise to the absurd notion, not yet entirely exploded, of the possibility of the formation of bubo without the precedence or concomitance of chancre.

The characters of the indurated chancre may be deduced from the account already given of artificial inoculation of the skin, which affords its best type. In order, however, to contrast its features with those of the soft chancre, it may be well here to reproduce the description of the principal phenomena which mark its progress.

The *indurated chancre*, fig. 82, is usually rounded or somewhat oval, and from the diameter of a split pea to that of a five cent piece. Its surface is hollow, as if scooped out, and incrusted with a layer of lymph, of a dirty grayish color, and very firmly adherent. The edges of the ulcer are hard, slightly elevated, and inclined a little slopingly from within outwards. The base is well-defined and remarkably hard, feeling, if pressed between the thumb and finger, like a button of fibro-cartilage, or, to employ the comparison of Benjamin Bell, like a split pea, set in the tissues immediately around the chancre. The induration begins to form about the end of the fifth day, and generally attains its maximum by the end of the tenth or twelfth. The amount of induration of the base varies; in general, it will be found to be less on the prepuce than on the head of the penis, the nature of the affected tissues doubtless influencing the result; and it usually lasts some time after the chancre is completely cicatrized, a circumstance, as will appear by and by, of great practical moment.

Fig. 82.



Indurated chancre.

The indurated chancre, if not generally solitary, is certainly so, on an average, in nearly five cases out of six; for I find that, of 848 cases observed by Fournier, Clerc and Hammond, 185 only were multiple. Occasionally, though rarely, the number ranges from two to six, or even as high as nineteen, as in an instance witnessed by Fournier.

It has no distinct areola; its march is indolent; and it furnishes a thin, serous, sanguinolent, or ichorous fluid, small in quantity, and difficult of inoculation. Hence, unless the matter come in contact with a raw surface, or a surface well adapted for its absorption, a second chancre seldom arises during the progress of the primary one. Another feature of the indurated chancre is its extreme liability to infect the lymphatic ganglions and the general system, few persons, if any, escaping contamination after it has reached maturity.

The *soft chancre*, also generally of a rounded form, but less regularly so than the hard, is much more common than the latter, and is often multiple, from three to six or eight occasionally occurring in the same subject. It is particularly apt to show itself at the free margin of the prepuce, and at, or just behind, the corona of the penis. Several often arise simultaneously, and others are liable to form during their progress from fresh inoculation, or the mere contact of their own secretion with the surrounding parts. The surface of the soft chancre is superficial, flat, uneven, and coated with a grayish, whitish, or dirty drab-colored deposit. In some cases it has a worm-eaten appearance. Its edges, when seated on the head of the penis, are steep and abrupt, as if made with a punch, but on the prepuce they are generally overhanging, sloping or shelving, extremely ragged, and less closely identified than those of the hard chancre with the neighboring structures. The base of the chancre is entirely free from induration. The only exception to this is where irritating applications have been used, causing an increase of inflammation with plastic deposit.

The soft chancre generally manifests a disposition to spread, and, in persons of a broken constitution, often takes on phagedenic action. It furnishes an abundance of purulent fluid, which is highly infectious, and therefore readily inoculable, thus accounting, as already stated, for the multiplication of ulcers during the progress of the disease, one sore being added to another in consequence of the dissemination of the matter over the surrounding surface. The soft chancre is frequently, but not generally, followed by bubo, the disease being usually limited to one ganglion, which, becoming inflamed and swollen, rapidly suppurates, and, in time, forms a large ulcer, the matter, like that of the chancre to which the bubo owes its origin, being at first inoculable, and capable, in turn, of producing a soft chancre. Finally, the soft chancre often affects the system, giving rise to secondary and tertiary symptoms; attacks of this kind, however, are less common than in the indurated variety, though the effects are frequently not less deplorable.

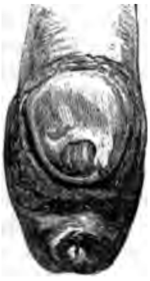
The period during which a chancre retains its specific character varies. Occasionally, though rarely, it loses its infecting properties in ten days or a fortnight. The average time, however, is much longer; and, on the other hand, an instance sometimes occurs where the specific poison continues to be formed for many consecutive months. As a general rule, it may be stated that no patient is safe so long as the ulcer is not in a granulating condition. The observations of Ricord tend to show that one attack of indurated chancre effectually protects both the part and system against a second attack, the syphilitic poison thus resembling, in its habits, the poison of smallpox; the soft chancre, on the contrary, exercises no such influence, one attack affording no immunity against another. My own experience leads me to believe that this conclusion should be received with great reserve.

The two varieties of chancre now described are liable to be modified in their appearances, progress, and modes of termination by local and constitutional circumstances, among which the most important are the want of cleanliness and the degree of the concomitant inflammation, the habits of the individual, the state of the general health at the time of the inoculation, and the occurrence of intercurrent diseases. The influence which these several causes are capable of exerting is, in many cases, so great as to change the whole outward feature of the existing ulcer; hence those numerous divisions and subdivisions of chancre which, even up to the present moment, disfigure the nomenclature of syphilis, and which have tended so much to embarrass the progress of our knowledge. It is impossible for this disease to observe the same uniform course in every instance; alterations are inevitable, and must often occur despite the utmost caution both of the patient and his attendant. In this respect, a chancre holds the same relation as an ordinary ulcer, presenting one appearance to-day and another to-morrow; now highly inflamed, and now almost free from irritation; at one time in a healing condition, and at another ready to commit the most destructive ravages. Out of these appearances, or varieties of appearances, have sprung the so-called inflammatory, diphtheritic, phagedenic, and sloughing chancres, with several others which it is unnecessary here to mention. Such occurrences constitute complications of disease rather than species and varieties, for they are liable to take place in all sores whatever their character, whether simple or malignant, specific or common. There is reason to believe that in syphilis the specific poison may sometimes undergo such a radical change as to adapt it, in an especial manner, for the production of these differences in the appearances of the local affection. Promiscuous intercourse with badly diseased women, particularly if these women are foreigners, and receive the embraces of a considerable number of men in rapid succession, would seem to be a powerful predisposing cause of these accidents. It was observed by the surgeons who accompanied the British army into Portugal, that many of the soldiers who had connection with the native prostitutes suffered severely from phagedenic and gangrenous ulcers, while the residents of the country experienced very little trouble, and usually soon recovered from the effects of the disease. The French soldiers, during Bonaparte's campaign in Egypt, suffered in the same manner. Similar phenomena are frequently witnessed in the inmates of the houses of ill-fame in crowded cities. Thus, in London, in Swan Alley, a narrow lane, celebrated as the residence of the humblest class of prostitutes, half-starved, badly clothed, nearly constantly intoxicated, and having frequent intercourse every day with filthy lascars and other vagabonds, many of the cases of chancre assume the worst possible type, running rapidly into phagedenic action, and often causing frightful ravages and even loss of life. Examples of a like kind came under my observation in this city, in 1827, 8, and 9, in the Philadelphia Almshouse, and in the numerous brothels which then existed among the low blacks and whites south of Pine Street.

All chancres are inflammatory affections, and it is only therefore when the concomitant action assumes a grave type that it can be regarded as unnatural. Under such circumstances, the characteristic symptoms consist of inordinate pain and swelling of the parts more directly involved in the disease, accompanied by an increase of discoloration, and an unhealthy aspect of the ulcer, which is the seat of a thin, ichorous discharge, more or less abundant, and generally a good deal irritating. Morbid erections are frequent, the prepuce is disposed to be œdematous, and the whole organ appears to be enlarged, especially the anterior extremity. When the inflammatory action transcends certain limits, it may pass into gangrene or destructive ulceration, as occasionally happens in common ulcers of the leg, and from similar causes, especially from excessive indulgence in the use of ardent spirits, loss of sleep, bad air, an impoverished diet, and improper courses of mercury. Or, the overaction may be brought on by a plethoric state of the system, and a neglect of the requisite depletion. I have seen gangrene and phagedenic ulceration of the genital organs of both sexes occur at a very early period, in consequence, apparently, merely of too active a course of treatment soon after the establishment of the disease, and such cases are sometimes characterized by extraordinary rapidity of progress, the suffering parts being, as it were, overwhelmed by the disease.

Gangrene, as a consequence of chancre, is more apt to invade the prepuce than the head of the penis, and, what is remarkable, the upper portion of this muco-cutaneous pouch is more frequently affected than the lower or lateral. Occasionally both structures are attacked simultaneously, or, if one suffer first, the other is soon attacked also, and in this manner the whole organ may gradually be involved, dropping off perhaps ultimately near the scrotum, or at its attachments to the pubic bones. The occurrence of gangrene is announced by a blackish spot, preceded and accompanied by a burning, smarting pain, and by an aggravation of all the other inflammatory symptoms. The system is extremely feverish, the pulse is frequent and irritable, sleep and appetite are impaired, or, more commonly, entirely destroyed, and the patient is often slightly delirious. When the prepuce alone suffers, the whole of it may slough off, or, what is not unusual, it may be perforated at one or more points, the largest opening perhaps admitting the head of the penis, as seen in fig. 83. A common effect of gangrene, consequent upon chancre, no matter where situated, is the destruction of the specific poison, thus effectually preventing inoculation of the system, provided that had not previously taken place.

Fig. 83.



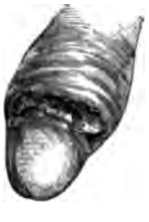
The sloughing sore, the prepuce almost gone; the glans going.

Phagedena is a rare complication of chancre, especially in the better classes of subjects; it is analogous, in its worst forms, to hospital gangrene, and is most liable to show itself in persons whose constitution has been ruined by intemperance and other debilitating influences. As already stated, it sometimes occurs as an endemic, and is then probably induced by a foul state of the atmosphere, as when the disease breaks out in the crowded wards of public institutions; or by some peculiar modification of the syphilitic poison, greatly heightening its virulence, as when it takes place in soldiers after having cohabited with foreign prostitutes. The morbid action deports itself variously; in general, it extends rather slowly, but continuously, gradually but effectually eroding the parts, and thus widening the breach as well as deepening it. Or, it may be that, as one portion of the chancre heals, another spreads. Or, the action may be very acute, extending with extraordinary rapidity, and committing excessive ravages in an almost incredibly short time. Or, lastly, the erosion may be conjoined with gangrene, the textures dying both molecularly and in mass. The phagedena may begin soon after the appearance of the chancre, or it may manifest itself, as is most generally the case, at various periods of its progress. It may occur upon any portion of the genital organs, but is most common upon those parts of the mucous surfaces which are most plentifully supplied with follicles. In the male it is most liable to appear in the gutter upon the head of the penis, or at the point of reflection of the prepuce. The under surface of the penis, at the side of the frenum, is another favorite site, and when chancre occurs here it is almost certain to destroy this fold of mucous membrane.

The appearances of the acute and chronic forms of phagedenic chancre are illustrated in figs. 84 and 85.

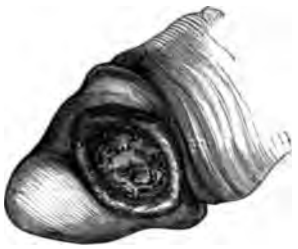
The phagedenic complication is sometimes followed by grave hemorrhage, the erosive action laying open an artery of considerable size, as the dorsal artery of the penis, from which blood may issue in such quantities as to induce severe, if not fatal, exhaustion. The scarlet hue of the fluid and the saltatory character of the stream will at once indicate its source. In some cases it oozes from the ulcerated surface from many points, as water oozes from a sponge.

Fig. 84.



Acute phagedena, burrowing beneath the integuments of the penis.

Fig. 85.



Chronic phagedena; with great surrounding hardness.

Chancres sometimes assume a *serpiginous* form, the erosive process, as the term implies, creeping about in different directions, generally in circles or semi-circles, one portion of the sore being perhaps cicatrized while the other is steadily advancing at the opposite point. The ulcer, although generally superficial, occasionally penetrates to a considerable depth, and, as its course is usually chronic, it often results in serious mutilation. Its surface, incrusted with grayish or drab-colored lymph, is bathed with ichorous fluid, and its edges are steep, ragged, and more or less everted. The serpiginous form of chancre is most common in persons of strumous constitution, especially such as are predisposed to phthisis, scurvy, and herpetic affections. It is generally remarkably obstinate, occurs almost exclusively in the skin, and manifests no disposition to burrow.

When a chancre is covered with a thick layer of lymph, it constitutes what the French syphilographers have called the *diphtheritic* chancre; such an occurrence is very common in all ill-conditioned specific ulcers upon the genital organs, and is always denotive of an unusually irritable and inflamed condition of the part, the action of which altogether transcends the healthy limits, nature being incapable of converting the deposit into granulations, and so throwing it off in the form of a slough, or as an effete substance. A considerable effusion of lymph is often observed in connection with the indurated chancre, but the soft chancre is by no means exempt from it.

Diagnosis.—The diagnosis of chancre is often difficult and sometimes impracticable, particularly in its earlier stages, before the disease has assumed its more distinctive features. The affections with which it is most liable to be confounded are herpes, eczema, balanitis, and simple excoriations, fissures, or abrasions, the result of friction and other accidents.

Herpes, as will be seen in its appropriate place, is an eruption of the prepuce and head of the penis, appearing in the form of little vesicles, hardly as large as the head of a pin, occurring in groups, closely set together, of a whitish color, and resting upon a florid base, with which they form a striking contrast. They are most frequent on the inner surface of the prepuce, in persons of red hair and tender skin, and often appear in successive crops, none of which last longer than six or eight days. They are characterized by a sense of itching and a slight serous discharge, manifest little disposition to extend, and usually promptly yield to very simple treatment. The resulting ulcer is always free from induration.

Chancres never put on the appearance of herpes. The only approach to it is where the specific ulcers are seated in the mucous follicles, but in this case their circular form and excavated character will always serve to distinguish them from common sores.

Eczema is also an eruptive disease, but the little vesicles are more minute and diffused than in herpes, and there is also usually a greater amount of local irritation, the parts being swollen, hot, red, and itchy. When these vesicles burst, a thin watery fluid escapes, followed by the development of little delicate scales. The affection is apt to become chronic, and then little crevices generally form, increasing the irritation, and furnishing an acrid, sero-purulent, sanious, or ichorous discharge. Eczema is most common on the prepuce, and is often particularly conspicuous at the free border of this mucocutaneous covering. A careful examination of the affected parts, the history of the case, and the co-existence of the disease with eczema elsewhere will always lead to a correct distinction between this affection and chancre.

It is probable that an inexperienced practitioner might mistake an incipient balanitis for a chancre, but no one who has ever seen the two diseases could possibly commit such an error. In balanitis the inflammation is generally widely diffused, often, indeed, over the whole surface of the prepuce and head of the penis, and the discharge is not only profuse but of a thick mucopurulent nature from the very commencement. There is no circumscribed ulceration as in chancre, and, indeed, no tendency whatever to destruction of tissue. These characters will always serve to prevent the disease from being confounded with chancre, which, whether indurated or soft, invariably presents itself as a distinct and well-defined ulcer.

Simple ulcers, abrasions, or excoriations are liable to appear upon the prepuce and head of the penis, and may, unless great caution is exercised, be mistaken for chancres. They may proceed from a great variety of causes, as want of cleanliness, friction of the pantaloons, injury received during connection, and intercourse with filthy females, especially such as are habitually the subjects of profuse and acrid discharges. However induced, such ulcers are always very superficial, and display no disposition to extend in depth, although they may spread considerably in diameter. The discharge which attends them is of an ichorous character, and they are usually surrounded by an inflammatory border, which is not the case in chancre. The most important diagnostic feature, however, by far, is that such ulcers always very promptly disappear under the most simple remedies, attention to cleanliness, with a cooling lotion and a mild aperient, generally sufficing to effect a cure in a few days.

The site, size, shape, appearance, and course of chancre, considered separately, afford no reliable diagnostic evidence; but viewed collectively they are of great importance as means of discrimination. Thus mere site and size are of no consequence, because a chancre may, like a common sore, occur on any portion of the penis and be very diminutive, as when, for instance, it occupies a mucous follicle; but if, in addition to this, the ulcer is found to be excavated, to have a foul diphtheritic bottom, to pursue a chronic course, and to resist the ordinary means of cure, it is quite impossible to mistake its character; we conclude that it is specific, and nothing else. The indurated chancre is too well marked not to be recognized; it may, it is true, not be so easy to do this during the first few days of the disease, but it is altogether impossible to be deceived when the sore has attained its proper development, the hardened base to which it owes its name being then of itself sufficient to settle any doubts respecting the diagnosis.

The history of the case often affords valuable information. If the patient is a married man, or if he has any other motive for concealment, he will be likely to deny that he has had impure connection, and even insist upon it that the sore on the penis is non-specific. Under such circumstances, it is not necessary to try to convict him of falsehood; the surgeon examines the parts, and if he finds any suspicious looking ulcers, he will be very apt to conclude that they are syphilitic, and this opinion will be strengthened by the very denials of the patient, especially if he is noted for his gallantries. Young unmarried men usually treat their attendants with entire candor, generally specifying with great particularity the time of the impure connection, and evincing no little anxiety to afford them all the light they can with a view of settling the diagnosis. We must, therefore, on the one hand, not believe that a man has not been exposed to infection simply because he says so; and, on the other, it must not be taken for granted that every sore that may be found upon the penis is of a specific nature.

Finally, in all cases of doubt the groins are to be examined with reference to the existence or non-existence of bubo. In the ordinary non-specific affections, above described, the occurrence of ganglionic enlargements is extremely rare, and when it does happen it usually appears early in the attack, the bubo being small in extent, at the same time that it is comparatively transient. In chancre, on the contrary, bubo seldom comes on before the end of the third week, and the swelling, besides being generally considerable, is always persistent, frequently passing into extensive suppuration and ulceration.

When the above means of diagnosis fail, which will seldom be the case if we are careful, the only other resource is inoculation, a small quantity of the suspected matter being inserted, upon the point of a lancet, in the skin on the inside of the thigh. If the operation is speedily followed by a vesicle, and this, in its turn, by a pustule, with a well-marked areola, there can be no doubt whatever respecting the true nature of the disease. Inoculation, if properly executed, cannot deceive, and is, therefore, after all, the only true and reliable test, although there are few surgeons of experience who will not, as a general rule, be able to determine the diagnosis without its aid.

Treatment.—The treatment of chancre must be conducted with a twofold object; the prevention of the absorption of the specific poison into the system, and the rapid and effectual healing of the sore. If the poison be permitted to enter the lymphatic vessels, constitutional contamination will be inevitable, and the result of such a vice may be a long train of evils, which may continue during the rest of the patient's life, and, if he be married, even show themselves in his offspring.

The prevention of the absorption of the virus constitutes what is called the *abortive* treatment, and should be an object of earnest solicitude in every case of the disease. Observation has proved that, if the specific character of a chancre can be effectually eradicated before the end of the fifth day from the inoculation, the constitution will completely escape contamination, the chancre being up to this time a purely local affection. The matter secreted by the indurated chancre, which is the more common, although, as has been seen, not the only source of infection, does not possess any specific properties prior to this period, or, if it do, it does not appear to be amenable to absorption until the part has acquired a certain degree of development, of which the hardened and circumscribed base forms a most important and characteristic element. Up to this time it is almost certain that the matter may, by proper management, be prevented from reaching the system, and exerting any deleterious impression upon it; but it is not equally certain that this procedure may not occasionally secure such immunity after this period, from the poison being unusually long delayed in the chancre, or, what is tantamount to this, from an indisposition on the part of the absorbents to carry it into the system. Hence, if there be no decided contra-indications, growing out of the existence of severe inflammation, or inordinate size of the sore, the patient should have the benefit of the abortive treatment even after the lapse of the first week or ten days, although the chances of success will then undoubtedly be much diminished, as far as the security of the system is concerned.

The abortive treatment is mainly of a local nature. The best plan of getting rid of the chancre is to dissect it out from the parts upon which it rests with a pair of forceps and a delicate bistoury, being careful to cut sufficiently widely around the diseased structures, so as to embrace the whole of them in the incisions. The operation requires some skill, but it is soon over, and, although a little painful, is rarely attended with any bleeding. Some caution is necessary, especially when the chancre has existed for an unusual length of time, to avoid inoculation of the wound; a circumstance which might readily happen if the surface of the sore were permitted to come in contact with it. When the excision is completed, the part is to be treated with mild measures, like any common wound, and will generally heal in a very short time.

If the patient be averse to the employment of the knife, or if the nature of the case be such as to induce the belief that excision cannot be effected without the danger of inoculating the raw surface, an attempt must be made to accomplish the object by means of escharotics. For this purpose several articles are in common use among the profession. The one most generally selected is a piece of nitrate of silver, cut to a very delicate point, and inserted into the ulcer, or broken vesicle, being held there until the infected tissues are brought thoroughly under its influence. The objection to this substance is its insufficiency; for, whether it acts simply as a neutralizer of the poison or as a destructive of the tissues, it is equally certain that it is generally unreliable, and hence it ought never to be used in a case of such a serious nature. The article to which I have long given the preference, on account of its superior efficacy, is the acid nitrate of mercury, prepared according to Bennett's formula, and applied either pure or variously diluted, according to the exigencies of each particular case. A good average strength is one part of the acid to double that quantity of water, applied with a piece of soft wood, the end of which is smooth and well rounded off. Such a contrivance is much better than a probe wrapped with lint or cotton, as the fluid can thus be brought in contact with the infected surface in a more concentrated and efficient manner. In order to prevent the solution from diffusing itself too widely, the parts should be previously well wiped, and immediately after bathed in pure water, or some weak alkaline lotion. The most suitable dressing will be an emollient poultice. When an escharotic is required, it is always better to make one free application than a number of imperfect ones.

When the acid nitrate of mercury is not at hand, the cauterization may be effected with almost any of the mineral acids, especially the nitric and hydrochloric. Some surgeons are in the habit of using caustic potassa, while others give a preference to the Vienna paste. Ricord has lately recommended a powerful caustic, composed of sulphuric acid and powdered vegetable charcoal, united in the proper proportions to form a semi-solid mass. Of this a thin layer is applied to the chancre and the parts immediately adjacent, upon which it soon dries, forming a black adherent crust, which, on dropping off, as it usually does in eight or ten days, leaves a healthy granulating sore, rapidly followed by cicatrization. The objections to the carbo-sulphuric paste are the extreme pain which it produces, and its tendency to spread too far over the sound tissues.

Conjointly with these local measures, it is necessary that the patient should be kept perfectly quiet for a few days, that his diet should be very light and non-stimulant, and that the bowels should be moved with some mild aperient. At the end of this time, unless there is evidence of undue inflammation, he may get up and go about his business.

The abortive treatment having failed, or the time having passed for its successful employment, the question necessarily arises, How shall the case be managed in order to secure a prompt and satisfactory result? Supposing the chancre to be one of a simple character, unaccompanied by severe inflammation, the treatment ought to be of a correspondingly simple nature, all harsh and irritating applications being studiously avoided, inasmuch as they never fail to do harm, and thus retard recovery. From neglect of this precaution many a sore upon the genital organs that would, if gently managed, disappear in a few days, is often protracted for weeks, if not months, to the great detriment both of the part and system. Young practitioners, in particular, are apt to fall into this error; their experience being limited, and their knowledge of the disease being derived from books rather than from clinical observation, they think they cannot do too much, and the consequence is that they fret and worry the sore until it places itself, so to speak, in a state of open rebellion, resenting all measures, local and constitutional, that are used for its cure. Instead of this, none but the most soothing means should be adopted, the object being to coax the disease, not to force it into terms.

One of the first and most important points to be attended to, in every case, is cleanliness. This is best secured by frequent ablutions, or, what is preferable, by immersion of the penis repeatedly during the twenty-four hours in tepid water, containing a little common salt, acetate of lead, or chloride of soda. If the chancre be concealed by a tight and inflamed prepuce, free use should be made of the syringe, as it will be impossible to effect retraction to an extent sufficient to accomplish the purpose. In the intervals of these local baths, which, while they serve to keep the parts nice and clean, contribute materially to the reduction of the concomitant inflammation, the ulcer should be kept constantly covered with a small piece of patent lint, wet with a weak solution of tannin and opium in compound spirits of lavender, yellow wash, or the dilute ointment of the nitrate of mercury, in the proportion of one part to six or eight parts of simple cerate. The tannin and opium constitute an excellent remedy, exerting at once an astringent and soothing influence, greatly promotive of healthy action. They form the principal ingredients of the aromatic wine, so much used in the French hospitals, and their efficacy has been well attested both in public and private practice everywhere. The yellow wash is also a very valuable remedy, but to obtain all the good which it is capable of yielding it should be employed very weak, as one-eighth of a grain of the mercury to the ounce of water, the strength being increased if it be found necessary on account of the slow progress of the case. The officinal preparation is much too strong and irritating, and must therefore be scrupulously abstained from. In my own practice I have derived great benefit from the ointment of the nitrate of mercury, diluted as above mentioned, and applied either alone or in union with tannin and opium. In fact, there is no remedy which has done better or more efficient service in my hands than this in the treatment of simple chancre. I am aware that by many all greasy articles are denounced as being injurious, in consequence of their alleged tendency to become decomposed and rancid. Such objections, however, can only be considered as having any force when these applications are too long continued, or when there is a want of attention to cleanliness, the secretions being allowed to accumulate unduly, so as to promote putrefaction. All this may be readily obviated by changing the dressings every five or six hours, and taking care that the ointment shall always be very fresh.

There is one important rule which applies here with as much force as in the case of common ulcers, and that is to vary the dressings whenever they are found to be unproductive of benefit, making them now weaker, now stronger, adding new ingredients, or omitting old ones, or changing the remedy altogether. Much of the success, in every case, will depend upon the care with which this rule of practice is carried out.

When the parts begin to granulate, the simplest dressings generally suffice; such as common ointment, Turner's cerate, diluted with five or six times its bulk of fresh lard, or merely a bit of dry lint carefully interposed between the contiguous surfaces. The latter application often promotes cicatrization with remarkable rapidity.

When the head of the penis is swollen and painful, it must be kept constantly buried in an emollient poultice, made of powdered elm bark or ground linseed, and frequently changed. Or, instead of this, the warm water-dressing may be used, its efficacy being increased by the addition of laudanum and acetate of lead. It need hardly be added that the organ should be incessantly maintained in an elevated position, just as any other part of the body in a state of inflammation.

Constitutional treatment is important, and must therefore claim due attention, however simple the sore. Perfect quietude of mind and body is indispensable in every case. The effects of any disturbance of this kind are sure to be promptly seen in the aspect of the sore and the character of the secretion. The diet must be plain and simple, animal food and stimulants being carefully avoided; the bowels must be kept open by cooling purgatives; and, if need be, free use must be made of the saline and antimonial mixture. Venesection will rarely be required, and then only in very plethoric subjects. If the local trouble be considerable, leeches may be applied to the groins or the inner surface of the thigh, care being taken to cover the bites, when the flow of blood has ceased, with collodion, in order to prevent their inoculation from the accidental contact of the chancrous matter. These animals should never be applied to the penis itself, much less to the parts immediately affected, as their secretions could hardly fail to come in contact with the little wounds, and so propagate the disease. If the ulcer belongs to the indurated variety, or if it be followed by a suppurating bubo, a moderate course of mercury will be proper; but as this is a subject which will come up for consideration by and by, it will not be necessary to enlarge upon it here.

Chancre, complicated with undue inflammation, phagedena, gangrene, or excessive inactivity, requires some modification of treatment, adapted to the peculiar conditions of the part and system which are always present under such circumstances, and which may, therefore, be regarded, in the true acceptation of the term, as so many exciting causes of the morbid action. It is only by bearing in mind the intimate relation subsisting between the local disorder and the state of the constitution, and the influence which they reciprocally exert upon each other, that the practitioner may hope to treat these epiphenomena with any immediate prospect of success.

When chancre is accompanied by severe *inflammation*, as denoted by the swollen, discolored, and painful condition of the parts, and the feverish state of the system, recourse must at once be had to the vigorous employment of antiphlogistics, for the purpose of moderating, as promptly as possible, the violence of the disease. Bleeding at the arm, active purgation, light diet, and the use of antimonials, with absolute rest in the recumbent posture, cooling, anodyne, and mildly astringent lotions to the ulcer, and an emollient poultice or the warm water-dressing for the head of the penis, constitute the chief remedies in such an emergency, and must be carried to an extent compatible with the powers of the system. Pain and morbid erections are relieved with opiates, administered in full doses. By these means the disease is soon brought under subjection, when it is to be managed in the same gentle manner as the milder forms of chancre already described.

When the ulcer assumes a *phagedenic* character, manifesting a disposition to spread more or less rapidly both in depth and diameter, the principal addition to the treatment, required in chancre complicated with undue inflammation, consists in the increased amount of opium employed to soothe the part and system, which are generally excessively irritable in this variety of morbid action, and can only be successfully quieted by the most liberal use of this article. If the skin be hot and arid, the pulse excited, and the face flushed, the opium should be combined with antimony, or some cooling diaphoretic, so as to produce a decided determination to the surface. The diet and bowels must receive due attention; all stimulants must be avoided; and the mind and body must be maintained in the most tranquil condition. If mercury has been given, its use is at once to be abandoned, experience having shown that, under such circumstances, it not only produces great harm, but that in many cases it is the principal cause of the phagedenic action.

The local applications should all be of the blandest kind, consisting of warm water-dressing or emollient poultices, and of lint steeped in mucilage of gum arabic, or an infusion of elm bark, with the addition, to each ounce of fluid, of from two to three drops of nitric acid and one drachm of the vinous tincture of opium. If the disintegrating action is very rapid, the ulcer should be touched freely with a solution of the acid nitrate of mercury, or a piece of solid nitrate of silver, its surface being kept constantly covered in the interval with the medicated lotion just mentioned. In some cases nothing will arrest the erosive tendency so speedily as a weak solution of sulphate of copper, in the proportion of from half a grain to a grain to the ounce of water, with the addition of from four to six grains of tannin and opium.

The phagedenic form of chancre, however, does not always occur in the strong and robust; the system may be, and often is, in an adynamic condition, requiring tonics and stimulants instead of depressants. The constitution, degraded perhaps by long suffering or by all kinds of intemperance and starvation, must be brought up by quinine and iron, with porter, ale, or milk punch, a nutritious diet, and change of air, particularly if the patient be the inmate of a crowded and ill-ventilated hospital. The dissipated and enervated residents of large cities are particularly prone to suffer from phagedena during the progress of chancre, and the practitioner, therefore, cannot be too much upon his guard how he depletes this class of individuals. What is needed in such a state of the system is perfect tranquillity of mind and body, as secured by the liberal exhibition of anodynes, and a better condition of the blood, to enable the part to institute a more salutary action.

If *gangrene* set in, the treatment must vary according to the concomitant state of the system, independently of any consideration growing out of the presence of the specific virus. The question should simply be, is the action on the part of the system too high or too low? If the former, antiphlogistics will be indicated, and should be promptly employed, although not without a certain degree of restriction, lest the powers of the constitution should suffer from the effect, and thus promote the spread of the disease. Bleeding and purgation must be used warily; the practitioner must measure his ground and feel his way. The excitement may only be apparent, not real; and may, consequently, shortly subside, either spontaneously, or under very simple remedies. Most likely the action is typhoid from the beginning, or, if not, it soon will be; hence, instead of a depletory, a corroborative course will be necessary, similar to that in ordinary gangrene in other parts of the body, our chief reliance, so far as constitutional means are concerned, being upon quinine, ammonia, brandy, camphor, and opium, with jelly and rich animal broths.

As it respects the part itself the indications are, first, to arrest the gangrenous action, and secondly, to promote the separation of the eschars. To fulfil the first of these objects, the affected structures are freely painted with the dilute tincture of iodine and wrapped up in an emollient poultice, medicated with laudanum and acetate of lead, while the dying tissues are well mopped with the acid nitrate of mercury, or brought under the full influence of the solid nitrate of silver. If any constriction exist, such as that produced by a tightened and retracted prepuce, it must be promptly relieved with the knife. The detachment of the sloughs may be promoted artificially, or, if not too large, be intrusted entirely to nature's efforts; at all events, all harsh interference must be carefully avoided. Fetor is allayed by the chlorides.

The sloughs having separated, the next object is to invite the development of healthy granulations; and for this purpose the most available remedies will be found to be the nitric acid lotion, with tincture of opium, the ointment of the balsam of Peru, the aromatic wine, or the dilute ointment of the nitrate of mercury, with the warm water-dressing or an emollient cataplasm, as a general covering to the affected structures.

Chancre attended with deficient action—the *indolent* sore of some syphilographers—demands for its successful management a careful investigation of the nature of the exciting cause of this particular state of the part before recourse be had to direct treatment. In general, it will be found to depend upon some defect of the system, by correcting which the ulcer will speedily assume a healthy appearance, throwing out florid granulations, furnishing thick, laudable pus, and cicatrizing along its margins. Or it may be that the obstacle is of a strictly local nature, caused by want of cleanliness, by an undermined condition of the sore, or, finally, by the presence of a thick, semi-organized layer of lymph, firmly adherent to the surface of the chancre. Whatever it may be, it should, if possible, be promptly rectified; the constitution, if at fault, is improved, and the part is treated with special reference to the promotion of the granulating process. Particular attention is given to cleanliness, the hardened and shelving edges are trimmed off with the knife, and the incrusted surface, freely cauterized with the nitrate of silver or acid nitrate of mercury, is kept constantly covered with blue ointment or some stimulating lotion.

The indolent form of chancre is frequently accompanied with an indurated base, which often continues a considerable period after the ulcer has become completely cicatrized, and constitutes a variety of primary syphilis peculiarly dangerous on account of its liability to be followed by constitutional symptoms. The idea now almost universally prevails that no person is safe from constitutional contamination so long as the part remains in this condition. It is an incontestable evidence that the specific virus still lingers at the original seat of the infection, and that, like a smothered fire, it may spring up at any moment into a full blaze, re-exciting ulceration, and endangering the system. It is to this form of chancre, more particularly, that mercurialization is applicable, very few patients thoroughly recovering without it. The manner in which it should be conducted has given rise to much discussion, and is deserving of special attention.

My own opinion is that the more simple and gentle the *mercurial* course is the better. It should be carried just far enough to affect the gums, and no farther. The object is not to cause profuse salivation, as was the wont of the older surgeons, but merely to produce slight soreness of the mouth, as an evidence of the constitutional impression, and to maintain this impression, in an equable, uniform manner, until the local affection has completely disappeared. The preparation which I usually prefer is calomel, in doses of from one to two grains three times a day, in union with a little opium, or, if there be dryness of the surface, with morphia and ipecacuanha. Blue mass is also a valuable article, and may often be employed as a substitute for the calomel, especially in the young and delicate. As soon as the medicine has produced a slightly salivant effect, or soreness of the gums, it is to be discontinued, or given in smaller doses and at longer intervals. If the desired result be slow in coming on, the treatment may be aided by mercurial inunction, from one to two drachms of the blue ointment being rubbed on the inside of the arms and thighs morning and evening.

I prefer calomel, blue mass, and mercurial ointment to the more modern preparations of mercury, chiefly for the reason that they are less liable to gripe, and also because they are more certain and reliable in their effects. Iodide of mercury, the article usually resorted to by modern practitioners, nearly always causes intestinal irritation, and is, as I know, from ample experience, generally very tardy and unsatisfactory in its action. The bichloride, so valuable in the tertiary form of syphilis, is not a reliable medicine in chancre, except, perhaps, in cases of extraordinary chronicity, in which I have sometimes given it with much benefit, in doses varying from the twelfth to the eighth of a grain every eight hours.

Mercury must not be employed, in any form, in the treatment of primary syphilis, if there be fever, or general excitement of the system. In such a case the patient must be subjected to a certain amount of preliminary treatment, consisting of rest, abstinence, purgation, and the use of salines and antimonials. A similar course is to be followed in phagedena and gangrene, or even when there is merely an unusually irritable state of the constitution. Exhibited under such circumstances, the mineral never fails to produce mischief, by increasing the local and general derangement. The great art of administering mercury in this and other diseases is to know when and how to give it; never to employ it sakelessly, or simply because it is mercury, but to give it for a good reason; and in order to do this properly a great deal more judgment is required than is generally imagined. Upon the manner in which the article is used in primary syphilis will, in great degree, depend the future welfare of the patient.

There can be no question that primary and even secondary syphilis are often curable without mercury. Every practitioner meets with instances where none but the most simple means are necessary to attain this object promptly and satisfactorily. For the last twenty years I have rarely given this mineral in any case of these two forms of the affection; and, although tertiary symptoms have occasionally supervened upon this mode of treatment, I have, on the whole, had no cause whatever to regret it, but quite the contrary. The value of the non-mercurial treatment was fairly tested, in hundreds, if not thousands, of cases, by the British surgeons, during the Peninsular wars, and their results, as published by some of their most enlightened and reliable brethren, prove, in the most irrefragable manner, that primary syphilis may generally be effectually relieved by ordinary antiphlogistic means. It was found that the average period occupied by the treatment of chancre unaccompanied by bubo, without mercury, was twenty-one days, a little more than twice this period being required when the sore was followed by bubo. On the other hand, the cases that were treated with mercury required, for the cure of the chancre, an average of thirty-five days, and for the chancre and bubo fifty days. The results of the practice of certain hospitals are equally corroborative of the value of this treatment. Thus, in the various hospitals of Sweden, of 20,000 cases treated with mercury, the number of relapses amounted to thirteen and two-thirds in the hundred; whereas, in a like number of cases treated by the simple method, the proportion of relapses was only seven and a half. In the Hamburg Hospital, out of 1649 patients, of both sexes, 582 were treated with mercury, and 1067 without mercury; the mean duration of the cure in the former was eighty-five days, and of the latter, fifty-one days. At Strasbourg, 5271 persons were treated without mercury, with hardly any relapses and secondary affections.

The above results are greatly in favor of the non-mercurial plan of treatment; and they deserve the more attention because it was formerly believed that the primary disease, when so relieved, is more liable to be followed by constitutional symptoms than when the patient gets well without the aid of the mineral. Finally, another fact developed by the British observers, and one repeatedly noticed in private and hospital practice since, is, that when mercury is exhibited in undue quantities, and especially in states of the system not properly prepared for its reception, the constitutional contamination is apt to be of the very worst kind, a sort of mercurio-syphilitic diathesis being established, which, in its remote effects, is more unrelenting and irradicable than the original disease, however severe.

If *hemorrhage* arise during the progress of chancre, no time should be lost in arresting it; the patient may be already much exhausted by previous suffering, and a slight drainage of this kind might therefore prove eminently prejudicial to his recovery. When the blood issues unmistakably from an open orifice, it should at once be secured by ligature or the compressing forceps, a sufficiency of tissue being included in their bite to insure safe maintenance. If, on the contrary, it proceeds from many points, the ordinary styptics will generally suffice for its arrest, especially if the system be promptly brought under the influence of opium.

The morbid *erections* which so often accompany chancre, and which generally so much impede the reparative process, must be treated in the same manner as in gonorrhœa; by the liberal use of anodynes by the mouth or rectum, and by soothing topical applications, either warm or cold, as may be most grateful to the part and system. If hemorrhage be present, they must be controlled at all hazards, on account of their tendency to tear open the bleeding vessels.

Phymosis, complicating chancre, must not be interfered with, unless it act constrictingly, threatening destruction of the prepuce and the glans by mortification. In this event, the parts must be freely divided upon the grooved director, the edges of the incision being immediately cauterized with nitrate of silver or acid nitrate of mercury, to prevent inoculation. In ordinary cases, the tightened foreskin is permitted to retain its place, cleanliness and medication of the ulcer being effected by means of the syringe, as already stated.

Paraphymosis is occasionally present, perhaps to a perplexing and even dangerous extent. The constriction produced by it may be such as to cause excessive œdema of the prepuce, and great engorgement, if not severe swelling, of the head of the penis; inducing a condition of things which, if not speedily relieved, may eventuate in extensive gangrene. These effects may be brought about whether the chancre be situated on the glans or on the retracted prepuce, and, for the reason just mentioned, always demand prompt attention. An attempt should be made to restore the parts by manual efforts, aided by chloroform, to give the surgeon more perfect command over his movements. This failing, the only alternative is to divide the stricture, care being taken afterwards to keep the wound well coated with collodion.

Chancre of the Urethra.—Chancre occasionally attacks the urethra; probably much oftener than is generally supposed, although its relative frequency to chancre of the prepuce and head of the penis has not been determined. The fact that this disease is liable to occur here was not known, even to the most enlightened syphilographers, until within a comparatively recent period, and hence it is not surprising that many of them should have considered gonorrhœa as capable, in some cases, of giving rise to secondary symptoms. The chancre being concealed in the urethra, the discharge which attended it was regarded as being exclusively the product of gonorrhœa, and the ignorance which existed upon the subject would probably never have been removed if it had not been for the practice of inoculation. The numerous experiments which have been performed upon the subject have proved, beyond the possibility of doubt or cavil, that gonorrhœa is a mere local affection, and that, whenever any constitutional syphilitic phenomena occur as a consequence of a urethral profluvium, those phenomena are due, not to the effects of gonorrhœa, but to those of a urethral chancre.

Chancre of the urethra is generally situated just behind the meatus, or in that portion of the tube which corresponds with the glans; I have, however, repeatedly met with it on the lips of the external orifice; and in the case of a young gentleman, recently under my care, I found a well-marked indurated chancre at least two inches behind the anterior extremity of the tube. The disease occasionally, though very rarely, extends over nearly the whole of the urethra, as far back as the neck of the bladder.

The period of latency of chancre of the urethra is much longer than in the ordinary form of the disease, which, on an average, does not exceed four or five days; here, on the contrary, it is rarely less than three and a half or four weeks. The reason of this would seem to be that the specific virus, being entangled in one or more of the lacunæ of the tube, is incapable of exciting the same rapid influence as when it is brought in contact with an abraded surface upon the head of the penis. Moreover, it is extremely probable that only a very small quantity of the poison generally finds its way into the urethra, and that, consequently, it has great difficulty, not merely in effecting a secure lodgment, but in so multiplying itself as to enable it to produce ultimately an explosive effect upon the mucous and submucous tissues. The urine, passing along the tube soon after the intromission of the specific fluid, will, in general, either wash it entirely away, or, combining with it, effectually neutralize its properties.

The discharge attendant upon chancre of the urethra is generally less copious than in ordinary gonorrhœa; it is also more thin, and of a lighter color, unless the accompanying inflammation is unusually severe, when it may be both profuse and of a thick, bloody character, or thick and yellow with a greenish tinge. There is generally some degree of scalding in micturition, though hardly ever as much as in gonorrhœa, and the site of the chancre is nearly always indicated by a sense of hardness, or a kind of lump easily distinguished by the thumb and finger. When the disease affects the anterior extremity of the tube, it is not uncommon to find great induration of the whole head of the penis with a red and phlogosed appearance of its mucous covering, and considerable tumefaction of the prepuce. Morbid erections are not only frequent but often very painful and troublesome. The disease is usually chronic, and rarely gives rise to fever, although it is liable to be followed by secondary and tertiary symptoms. Bubo is not one of its ordinary effects; but a certain amount of contraction of the urethra nearly always is.

The *diagnosis* of chancre of the urethra is often difficult. It is certainly easy enough when the ulcer is situated at the lips of the meatus, or just behind the orifice, the separation of the edges of which will then bring it fully into view, or, at all events, to an extent sufficiently satisfactory. When located farther back, its existence becomes a matter of doubt; for, although the induration which accompanies it may be very distinct, yet as a similar condition may be present in gonorrhœa, in consequence of the development of an abscess, or the escape of a drop of urine into the submucous cellular tissue, no useful deduction can be drawn from it. Perhaps the most valuable rational symptoms are, the unusual latency of the poison, or the extraordinary length of time which intervenes between the impure connection and the outbreak of the disease, the remarkable obstinacy of the attack, resisting, as it generally does, all the various methods of treatment which are commonly directed for the cure of gonorrhœa, and, lastly, the slight scalding in micturition, and the frequent variation in the nature of the discharge, which is now scanty, thin, and serous, and now profuse, thick, and yellow. The only real diagnostic character, however, is furnished by inoculation, which should be promptly resorted to in all cases of doubt on account of the selection of a proper and efficient course of treatment.

The *treatment* of chancre of the urethra is to be conducted upon general anti-syphilitic principles. The remedies which prove so serviceable in gonorrhœa are entirely inert here, except in so far as they may be instrumental in diluting the urine and depriving it of its acrimony. When within reach gentle cauterization with nitrate of silver will be beneficial, and, in obstinate cases, hardly any other direct application will be of much avail. In the intervals of the cauterization, or, in the more intractable forms of the disease, throughout the treatment, different kinds of injections must be used, especially weak lotions of sulphate of copper, tannin, and opium, acetate of lead, bichloride of mercury, and iodide of iron. If the sore be seated near the meatus, the opposite surfaces should be kept apart with a tent medicated with the dilute ointment of the nitrate of mercury; or a small bougie smeared with this substance may occasionally be introduced. If marked induration exist, early but gentle mercurialization must be employed, both as a means of promptly curing the chancre, and of protecting the system from contamination.

Chancre in the Female.—Chancre in the female is most common upon the vulva, in the vagina, and upon the uterus, the relative frequency of the occurrence being in the order here stated. The perineum also sometimes suffers. The inferior portion of the vagina is much more liable to be affected than the superior, but both this part of the tube and the uterus are not nearly as often the seat of the indurated, or true Hunterian chancre, as was at one time supposed, owing probably to the fact that the infecting matter which covers the sore of the penis is wiped off during coitus before the organ has effected full penetration. The nature of the ulcer is easily recognized by its excavated shape, its steep, irregular edges, its foul, unhealthy-looking bottom, and its indurated base. In chronic chancre of the uterus, the hardness is generally wide-spread and most characteristic, the neck and mouth of the organ being almost of a stony consistence, deeply engorged, and of a florid hue.

The soft or non-indurated chancre is much more common than the indurated, the two varieties of sore following, in this and other respects, the same laws in the female as in the male. The former is often multiple, and may acquire a large size; the latter, on the contrary, is usually single, and almost always very small, its dimensions rarely exceeding those of a five cent piece. Both classes of ulcers are frequently the seat of excessive pain, especially when they attack the vulva and the inferior portion of the vagina. Their march is generally chronic, and their presence can only be satisfactorily determined by careful ocular inspection. In regard to their diagnosis, the surgeon must be guided principally by the history of the case, the character of the patient, and the appearance of the ulcers. When the ordinary means of discrimination fail, inoculation must be practised.

In the treatment of chancre in the female, the same general rules are to be observed as in the treatment of chancre in the other sex. Absolute rest in the recumbent posture, active purgation, the saline and antimonial mixture, anodynes, diaphoretics, the warm bath, and light diet constitute the principal constitutional remedies. The most important topical means are frequent injections of cold water, or cold water impregnated with some mild anodyne and astringent articles; cauterization with the solid nitrate of silver or the dilute acid nitrate of mercury; and isolation of the sores by tents of patent lint, medicated with aromatic wine, lotions of tannin and opium, yellow wash, or some slightly stimulating unguent, especially the dilute ointment of nitrate of mercury. In obstinate cases, especially in the indurated chancre, a mild course of mercury will be necessary.

2. BUBO.

Bubo is an enlargement of one or more of the lymphatic ganglions of the groin. It may proceed from a great variety of causes, tending to irritate and inflame the lymphatic vessels leading to these glands; thus it may be occasioned by gonorrhœa, excessive sexual indulgence, fatigue from protracted exercise, injury of the inferior extremity, or the presence of a boil upon the nates, thigh, or perineum. Such swellings are particularly liable to occur in young subjects of a scrofulous temperament, in whom they often arise from the most trivial causes, and generally disappear without much, if any, treatment; the concomitant inflammation being usually very slight and seldom passing into suppuration. The syphilitic bubo, on the contrary, is a specific disease, the result of inoculation with the matter of chancre, and capable of furnishing a secretion similar to that by which it was itself produced. An open syphilitic bubo is, in fact, a chancre, and nothing else. Hence, like the latter, it constitutes merely a form of primary disease; for so long as the poison is limited to the glands of the groin there cannot, of course, be any true contamination of the system. It is only when it passes beyond this point that its operation can become general; up to that period syphilis is essentially a local affection.

The true syphilitic bubo rarely arises until the end of the second week, or the beginning of the third from the appearance of the original sore; cases sometimes occur at an earlier period, as the seventh or eighth day, and, on the other hand, the attack may be postponed until the close of the first month. Some authorities, Puche among the rest, would have us to believe that the disease may occasionally not show itself until after the lapse of three years. Such a statement, although apparently credited by respectable authorities, is too ridiculous to be seriously entertained by any one. Nature undoubtedly constantly deviates from her established laws, but it is impossible to suppose that she could be guilty of so great a departure as such an occurrence as this would imply. We must rather conclude that the fault lies in a want of correct observation than in such a flagrant violation of the laws of syphilis.

Bubo may follow either the soft or the indurated chancre, but in order to do this it is necessary, as a general rule, that the sore should be free from phagedena and gangrene, or, indeed, from severe inflammation of any kind, inasmuch as the absorption of the specific virus and its transmission to the groin are accomplished with great difficulty when the parts are overpowered by disease. An active, open state of the ulcer, and the smallest conceivable amount of inflammation in the structures immediately around, are, other things being equal, the conditions which are the most favorable to the development of the true syphilitic bubo. Considerable diversity exists in respect to the aptitude with which the two varieties of chancre produce bubo, as well as in regard to the characters of the bubo itself. Thus, the indurated chancre is always followed by bubo, the swelling, which usually involves several ganglions, being hard and chronic, and partaking more or less of the character of the parent sore, without much disposition to suppurate, although it is sure eventually to contaminate the constitution. The pus, moreover, which occasionally forms, is not generally specific, and is for the most part of a thin, ichorous nature. The soft chancre, on the other hand, is only now and then followed by bubo; the disease, which attacks only one gland, always runs its course very rapidly, and soon terminates in the formation of an abscess, the fluid being both abundant and readily inoculable.

However produced, the specific bubo will generally be found to occur on the same side as the chancre. Thus, if the ulcer exist on the right side of the penis, the right groin will be the one to suffer, and conversely. Now and then an exception to this rule is met with, depending, probably, upon an interlacement of the lymphatic vessels, those of the right side passing over to the left, and the reverse. A bad form of bubo occasionally occurs at the root of the penis, or upon the pubes, caused by the presence of an infected ganglion.

Both sexes are liable to syphilitic bubo; but males suffer much more frequently than females, owing to the difference in the arrangement of the lymphatic vessels, those of the former passing in a much more direct manner than those of the latter from the seat of the disease. In chancre of the uterus and upper part of the vagina bubo is uncommon, and the same law holds good in chancre of the urethra in men.

The relative proportion of bubo to chancre has not been settled; while the indurated form of the disease is very generally followed by swelling of the inguinal glands, soft chancre does not perhaps produce such an effect oftener than in one case out of four.

An opinion has extensively prevailed during the last twenty years, or more, that a bubo may form in the groin without the intervention or antecedence of a chancre, in consequence of the direct absorption of the specific poison from a mucous or cutaneous surface. It is maintained by the advocates of this doctrine that such an effect is possible, because, as they allege, bubo and even constitutional symptoms occasionally occur without any evidence whatever of their having been preceded by primary ulcers upon the genitals. They assume that the matter in which the poison is entangled, or held, as it were, in solution, may be absorbed by the mucous or even the cutaneous surface of the penis in the same manner, and upon the same principle, as morphine, atropine, and other articles of the materia medica, and that, being subsequently conveyed by the lymphatic vessels to the groin, it is capable of infecting its glands in such a way as to form a true syphilitic bubo. Hence, the disease has been called the primary non-consecutive bubo, or, to use a French phrase, *bubon d'emblée.* The existence of this variety of inguinal enlargement was admitted by several of the older writers on syphilis, especially by Astruc and Swediaur, and has been dwelt upon at much length by Ricord and his disciples. Many of the most experienced practitioners, however, in all parts of the world, positively assert that they have never met with it, and, as for myself, I am quite sure that no instance of the kind has ever fallen under my observation. My belief, therefore, is that the occurrence is a mere chimera, explicable on the supposition that the chancre which precedes it is so small and evanescent as to elude detection. It is certain that such slight and transient ulcers often do appear on the genital organs of both sexes, and that, notwithstanding they do not attract any attention either on the part of the patient or his attendant, they are yet not unfrequently followed by the worst forms of constitutional contamination.

An excellent observer, Dr. Bumstead, of New York, in his able work on venereal diseases, in speaking of this subject, makes the following very apposite remarks:—"The existence of a bubon d'emblée, secreting inoculable pus and capable of infecting the constitution, is entirely inconsistent with our present knowledge of venereal diseases, and cannot now, as formerly, be admitted. The reported cases of this character are very far from being conclusive."

Varieties.—Bubo, like chancre, is susceptible of a great variety of forms. Thus, it may, after having progressed a certain distance, remain stationary, perhaps even several months, manifesting no decided disposition either to advance or to recede. Conjoined with this indolent, passive, or inactive state is generally a certain degree of hardening, such as we so often observe in the chronic indurated ulcer upon the head of the penis. Such a swelling is always to be dreaded on account of the disposition which the specific poison has to lurk in the substance of the affected glands, from which, in time, there is great danger of its being conveyed into the system, so as to give rise ultimately to secondary and tertiary symptoms. The bubo, in fact, is a hot-bed, not merely for the temporary lodgment of the virus, but for its zymotic operation, and its gradual extension to other and more important structures.

In another class of cases the enlarged glands, taking on inordinate inflammatory action, pass into *suppuration*, the matter usually collecting in a solitary abscess, of an ovoidal shape, and from the volume of an almond up to that of a goose's egg. When the disease assumes this form, it generally runs its course with considerable rapidity, being characterized by severe constitutional disturbance, such as rigors, fever, and headache, and by intense local suffering, the pain being of an aching, throbbing character, the swelling great, the heat excessive, and the discoloration of a dusky livid red. If the matter, which is generally of a thick, yellowish appearance, intermingled with blood and cellular sloughs, be not promptly evacuated, it is apt to burrow among the neighboring tissues, causing extensive sinuses, which it is often extremely difficult to heal, and which occasionally lay open most important structures. In neglected cases I have seen such an abscess, more than once, pass high up over the abdomen, and low down upon the front of the thigh. In the indurated bubo, the result usually of an indurated chancre, the secretion is generally comparatively scanty, and of a thin, ichorous, sanious, or sanguinolent nature. Whenever the quantity of matter is unusually large, it may be assumed that it is furnished by the cellular tissue in which the affected glands are wrapt up rather than by the glands themselves.

When the contents of the abscess have been discharged, whether spontaneously or otherwise, the disease takes the name of an open or *ulcerated* bubo, a state in which it may remain, with very little change, for an almost indefinite period. The discharge from such a sore, which is always situated above Poupart's ligament, and which inclines from above downwards and inwards, may partake more or less of the character of laudable pus, or it may, as most generally happens, be thin, ichorous, and irritating, its quantity varying from several drachms to upwards of an ounce in the twenty-four hours. How long it may retain its specific properties is unknown. The edges of the sore exhibit very much the same appearances as those of a common chancre; thus, they may be very steep, hard, and ragged; everted, inverted, or undermined; thick or thin; pale, reddish, dusky or purple. The bottom is usually incrusted with a dirty, greenish, or yellowish pultaceous substance, with here and there a small, fiery looking, exquisitely sensitive granulation. Sinuses often extend from the main ulcer in different directions, and it is not uncommon, when the destruction has been at all extensive, to see some of the affected ganglions lying in a partially detached state at the bottom of the sore, perhaps adhering merely by a few shreds of cellular tissue.

An ulcerated bubo may take on *phagedenic* action, extending more or less rapidly in different directions, just as in the case of a chancre occurring in an unhealthy constitution. This epiphenomenon may show itself soon after the swelling has been laid open, or not until after the lapse of several weeks or months. It is usually characterized by severe pain, by a thin, profuse, sanious discharge, and by a foul pultaceous state of the sore, along with an irritable condition of the system, want of appetite and sleep, and disorder of the alimentary canal.

Finally, a syphilitic bubo may become the seat of *gangrene;* sometimes before ulceration sets in, but usually not until afterwards. Such a termination is most apt to occur in the lower classes of patients, the inmates of cellars, prisons, almshouses, and other filthy places, and often produces the most frightful ravages, causing extensive destruction of the skin and cellular tissue, as well as, in some cases, of the muscles of the abdomen. The symptoms are generally very severe, and the disease often proves fatal, the sufferer, meanwhile, forming a most loathsome and disgusting object.

Diagnosis.—Syphilitic bubo is liable to be confounded with bubo from other causes, and hence it is by no means always easy to determine the diagnosis, desirable as it is that there should be no mistake upon a subject of such practical moment. There are a few points in connection with these two classes of swelling which are deserving of attention as means of discrimination. In the first place, the surgeon must carefully consider the history of the case. If the bubo be of a syphilitic nature it will not, as a general rule, come on until the end of the second week from the primary disease, and in many instances, indeed, not until a considerably later period. In the common bubo, on the contrary, the swelling usually supervenes within a short time after the exciting cause has begun to act. Thus, a boil upon the nates, or a corn, bruise, or other injury of the toe, is usually followed by a bubo within the first three or four days after the local affection has sprung up. Secondly, useful information may be obtained from the duration of the swelling. A syphilitic bubo usually lasts a number of weeks, often, indeed, several months; an ordinary bubo, on the other hand, generally promptly disappears with the exciting cause that induced it. Thirdly, the specific bubo often suppurates and ulcerates; the common bubo seldom, if ever, and then only in persons of a scrofulous and broken constitution. Fourthly, the matter of the syphilitic bubo is often inoculable; of the common, never. Finally, the syphilitic swelling is always situated above Poupart's ligament, affecting mostly only one gland; the non-syphilitic swelling, on the contrary, is usually situated below that band, or partly below and partly above, and generally attacks several ganglions, though rarely in an equal degree.

The scrofulous bubo occurs only in persons of a scrofulous diathesis, mostly in children prior to the age of puberty. It commonly affects a considerable number of glands simultaneously, and they remain enlarged for a long time, being very hard and lobulated, and slowly tending to suppuration. The matter is of a yellow-greenish hue, and collects in several little abscesses, which, bursting, leave ill-conditioned ulcers, with thin, bluish, undermined edges, and a thin, sanious, irritating discharge, destitute of inoculable properties. The bulk of the swelling is usually situated beneath Poupart's ligament, at the upper and inner part of the thigh; and traces of strumous disease generally occur in other parts of the body.

Treatment.—The treatment of bubo must be conducted upon the same general principles as that of chancre, of which, as already stated, it is simply another form. If the disease be seen early, before there is much inflammatory action or any decided tendency to suppuration, the abortive treatment will come in play, consisting of the free application of tincture of iodine, and of concentrated compression, either with a truss, or a series of linen pads and the spica bandage. There are few cases of incipient bubo which can resist the combined influence of these remedies, if properly managed. If the compression, in the efficacy of which I have great confidence, proves painful, it must be moderated, or altogether pretermitted for a time. Occasionally the treatment is advantageously preceded by the application of leeches.

If the disease has already made considerable progress, iodine and compression will probably prove insufficient, and then more active measures will be required. Of these, the most efficient is the formation of an eschar upon the most prominent portion of the swelling by means of the Vienna paste, applied as in making an issue, or a solution of bichloride of mercury, in the proportion of twenty grains to the ounce of alcohol. The skin having been previously elevated by a small blister, a compress wet with the lotion is firmly bound upon the raw surface, and retained for two hours, when it is replaced by an emollient poultice or the warm water-dressing. The pains produced by this application are excessive, and hence the paste usually deserves the preference, especially as it does not possess any special therapeutic advantages. The new action created by the caustic neutralizes or overwhelms the pre-existing, and rapidly destroys the specific disease.

When suppuration is threatened, or inevitable, the process should be expedited by the usual means, aided by recumbency and a relaxed position of the lower extremity. As soon as fluctuation is observed, the parts are freely divided, even if the matter be deep-seated, in order to give full vent to the confined fluid. A tent is kept in the opening to prevent closure of its edges. The incision should always be made in the direction of Poupart's ligament. If the bubo is chronic and indurated, the operation is sometimes attended with considerable hemorrhage, chiefly, however, of a venous nature, and consequently easily arrested by pressure and quietude. When the suppurative process is very slow and imperfect, as it sometimes is, especially in the variety of bubo just mentioned, the most appropriate application is a large blister, retained sufficiently long to produce thorough vesication, and dressed with an emollient poultice. When the accumulation of pus is very large, it has been proposed to effect its evacuation, not by incision, but by a number of punctures, on the ground that the procedure would be less destructive to the integument than the more common operation. I have not, however, found such a result to obtain in my own practice. On the contrary, the skin and cellular substance are generally so much detached and impoverished as to render it impossible to preserve them with any reasonable prospect of their ultimate reunion. Hence, I am always in favor of a free division; nor do I hesitate afterwards to remove such portions of integument as may seem to act obstructingly to the reparative process by overhanging the surface of the ulcer, and interfering with its medication. If sinuses form, they must be laid open in the usual manner: fungous granulations are repressed with escharotics, as sulphate of copper and nitrate of silver, or, what is better, the scissors. If the constitution is impaired by protracted suffering and confinement, tonics and change of air will be required; and in all cases proper attention is paid to the diet, the bowels, and the secretions. Should phagedena or gangrene supervene, the same line of treatment will be demanded as under similar circumstances in chancre. The chronic indurated bubo will rarely yield in a satisfactory manner until the system is brought gently under the influence of mercury.

SECT. III.—SECONDARY SYPHILIS.

1. GENERAL CONSIDERATIONS.

The term secondary is employed to designate that group of morbid phenomena which manifest themselves after the occurrence of primary syphilis, the period of their evolution varying, on an average, from five to eight weeks from the first outbreak of the disease. The structures which are most liable to suffer are the cutaneous and mucous, and these may be attacked either simultaneously or consecutively, or one may suffer and the other escape, according to the condition in which they may happen to be at the time of the contamination.

Secondary syphilis is always preceded by chancre, for there is no reason to believe, as has been stated elsewhere, that the specific virus ever finds its way into the system by direct imbibition, or without the intervention of a breach of continuity of some kind or other. This fact is too well established to admit of any doubt. Bubo, however, does not always precede it; in many cases, in fact, the inguinal glands remain completely intact, and yet the constitutional symptoms may be of the very worst character, occurring, perhaps, early after the primary disease, and exploding with peculiar virulence upon the cutaneous and mucous tissues. It would be interesting, in a practical point of view, if we could determine the relative frequency of secondary symptoms and bubo, or how often in a given number of cases constitutional syphilis occurs with involvement of the inguinal glands, and, on the other hand, how often bubo exists without being followed by consecutive derangement. For the solution of this question, however, there are, unfortunately, no sufficient data. As was previously stated, the indurated chancre is nearly always succeeded by constitutional involvement, occurring early in the disease, and generally giving rise to the most serious, if not to positively irremediable, effects. It has lately been insisted upon by certain authorities that the soft or non-indurated chancre is solely a local affection, and therefore never followed by any specific vice of the general system. In this doctrine I cannot agree, for I can see no reason, on general pathological principles, why an ulcer which furnishes an infectious virus, as the soft chancre is well known to do, should be capable of inoculating certain tissues and not others; why, in other words, it should be able to reproduce itself locally, and yet not be able to affect, implicate, or contaminate the constitution. To assume the possibility of such an occurrence would be, as has been remarked elsewhere, to suppose that there are two distinct poisons, a view which is contrary to all reason, science, and analogy, and therefore altogether untenable. But the observant practitioner is not driven to the adoption of so absurd a conclusion; he appeals to his personal experience, and is satisfied that he has repeatedly seen the very worst cases of secondary symptoms succeed to the soft chancre. I am sure it has repeatedly fallen to my lot to witness such effects, and I therefore regard this doctrine as a most pernicious one, calculated as it is, if practically followed, to throw the surgeon off his guard, and thus prevent him from adopting a suitable treatment for the relief of his patient.

Secondary symptoms often come on before the primary have disappeared; a chancre, indeed, may, so to speak, be in full bloom, and continue to furnish an abundance of specific virus, and yet the constitutional disease have already made considerable progress, the skin being perhaps covered with eruptions, the throat inflamed or ulcerated, and the tongue affected with tubercles, thus showing thorough contamination both of the solids and fluids. Or, the chancre may have become cicatrized, but remain hard and tender, more or less of the specific poison lurking in the affected tissues, ready to ferment and break out anew from the most trivial causes. Or, the original sore may have got entirely well, but the bubo be still in action, either as an indurated swelling, or as an ulcer with more or less discharge. Or, lastly, and as is perhaps most commonly the case, the secondary complaint does not display itself until some time after the primary has completely disappeared, and the patient has perhaps imagined himself perfectly well.

It is generally impossible to determine, in advance, what effect a chancre may exert upon the system; or, in other words, whether it will be likely to lead to constitutional contamination. There are certain circumstances, however, which, like coming events, cast their shadow before them, and thus serve to enable the attendant to form at least a plausible conjecture, if not a positive conclusion, in respect to the future condition of the system. These circumstances may be arranged under the following heads :—

1st. It is now generally, if not universally, admitted that the indurated chancre is nearly always followed by secondary symptoms; often, if not usually, coming on before the primary sore is completely healed, and producing a degree of contamination which it is extremely difficult, if not impossible, to eradicate completely from the system. The constitution, once affected, nearly always retains the peculiar impress which it has received from the virus, in so much that the disease is probably capable of being propagated from parent to offspring during a series of generations.

2d. The non-indurated chancre, if multiple or of great extent, will, other things being equal, be more likely to give rise to constitutional involvement than a single sore, especially if superficial and of small size.

3d. The site of the chancre probably exerts some influence upon the production of secondary symptoms. Thus, there is reason to believe that a specific ulcer seated upon the inner surface of the prepuce, or at the free border of this muco-cutaneous fold, will be more likely to lead to contamination of the system than a chancre on the head of the penis, owing probably to the greater activity of the absorbent vessels in the former than in the latter. A chancre of the urethra is rarely followed by constitutional infection.

4th. Constitutional involvement is also influenced by the duration of the chancre. It has been conclusively shown that if a chancre, even if it pertain to the indurated variety, be cured or removed before the end of the fifth day from the time of the inoculation, there is, as a general rule, no risk whatever of systemic contamination; and it is perfectly reasonable to suppose that the chances of absorption of the specific virus will be much diminished, in every case, whatever may be the nature or site of the sore, in proportion to the shortness of its duration. Hence the absolute importance of getting rid of such a sore in the most summary and thorough manner.

5th. The state of the patient's health greatly influences the production of secondary syphilis. If he be stout and robust, and, in every respect, well conditioned, both as it concerns his solids and fluids, the poison will be much less likely to be conveyed into the system than if he be feeble and exhausted by disease, or laboring under a strumous or scorbutic cachexia.

6th. The kind of treatment also produces a marked effect upon the occurrence of a syphilitic diathesis. There is no doubt at all that, as a general rule, secondary symptoms are much more liable to declare themselves if mercury be given for the primary disease than when the cure is accomplished without it. The results of upwards of 80,000 cases, treated by the simple method in various parts of the world, conclusively establish this fact.

7th. The degree and character of the inflammatory action accompanying the chancre often greatly influence the occurrence or non-occurrence of constitutional symptoms. When the inflammation is unusually severe, or of a highly phagedenic type, absorption will be kept in abeyance, and the system escape contamination. Gangrene, supervening early in the progress of the chancre, always prevents the absorption of the specific virus.

Finally, it is not improbable that the occurrence of secondary accidents is materially influenced by individual peculiarity or idiosyncrasy. It is well known that some persons contract primary syphilis with great difficulty, and, on the other hand, there are some who can never touch an infected female without being inoculated. The same is true of secondary syphilis. Thus, one man whose penis is literally covered with chancres may escape constitutional contamination entirely, while another, who has only a small sore precisely of the same kind, may suffer very severely. There must be great individual peculiarities in regard to the susceptibilities to the action of this poison, otherwise it would be impossible to account for the remarkable diversities which characterize the evolution and course of this disease in different persons.

Secondary syphilis is not *contagious*, thus showing that the specific virus, after it has fully entered the system, undergoes changes which essentially modify its properties and disqualify it for the production of an inoculable disease. I am aware that a contrary opinion has been held by some very eminent authorities, and that the experiments of Vidal, Cazenave, and others, with the pus of syphilitic ecthyma, would seem to countenance such a view; but it is impossible not to believe that these distinguished syphilographers, in their zeal to promote the interests of science, were deceived by accidental circumstances connected with the state of the system of those who were the subjects of their researches, causing it to give rise to an appearance similar to, but by no means identical with, that of a chancre or an infectious pustule. Indeed, if such an occurrence were possible it would manifest itself constantly during the progress of secondary syphilis in consequence of the secretions coming in contact with raw surfaces upon the skin and mucous membranes.

But, although secondary syphilis is not contagious, it is *transmissible* from the parent to the offspring, probably not merely through one but through many generations, the result declaring itself in a great variety of affections, and often proving destructive to the new being, sometimes before birth and other times not until afterwards. The very stream of life is poisoned, and all those who partake of it are destined to suffer from its effects, this being at least one way in which "God visits the iniquity of the fathers on their children, down to the third and fourth generation." The very fact that the disease is transmissible shows that the whole system of the individual is impregnated with the specific poison, every globule of blood and every particle of solid matter being impressed by it. It is this pervasive, universal influence that has led to the opinion, now very general on the part of the best educated members of the profession, that constitutional syphilis is seldom, if ever, completely eradicable. Once implanted in the system, its germ is probably indestructible.

Secondary syphilis is usually ushered in by well-marked *constitutional* phenomena. Generally some days—frequently as many as eight or ten—before there is any evident local disease, the patient feels conscious that he is unwell, or that there is something wrong about him; he is in a state of *malaise*, or in that uncomfortable condition in which a man is neither well nor yet decidedly sick. Prominent among these symptoms is his mental dejection; he is gloomy and desponding, indulging in unpleasant forebodings, and unable to apply himself to business; his countenance assumes a dull, muddy appearance; his hair becomes dry and rough; his limbs and joints feel sore and stiff; his appetite is indifferent; the bowels are inclined to be costive; the urine is scanty and high-colored; exercise soon fatigues; and the sleep, disturbed by frequent dreams, is unrefreshing. Gradually, after the lapse of a few days, or, it may be, all of a sudden, the patient is seized with chilly sensations, or actual rigors, followed by high fever, or by fever and profuse sweats. The attack, which constitutes what is called *syphilitic fever*, is manifestly an effort of the system to eliminate the specific poison, and the tissues upon which it usually explodes are, as was previously stated, the cutaneous and mucous, together with the posterior cervical ganglions, the morbid phenomena of the former exhibiting themselves in various eruptions, and of the latter in ulcers of the throat and tubercles of the tongue. The iris may also be enumerated as liable to suffer from secondary involvement.

2. AFFECTIONS OF THE SKIN.

The syphilitic affections of the skin, the *syphilides*, as they have been termed by Alibert, manifest themselves under at least six varieties of form, the exanthematous, scaly, vesicular, pustular, tubercular, and papular. Of these, however, the last three, in consequence of the lateness of their appearance and the severity of their character, may be regarded rather as appertaining to the tertiary order of phenomena than to the secondary. Of the other three, two are not unfrequently coincident with the primary disease, although, in general, they do not show themselves until some time afterwards. The syphilitic eruptions nearly always pursue a chronic course, are more or less circular in their form, and always exhibit a characteristic copper color, especially in their earlier stages; for, after they have existed for some time, they are very apt to assume a grayish, muddy, or bronze appearance, owing to some modification in the coloring matter of the skin. Although occurring upon all parts of the cutaneous surface, they are usually most conspicuous upon the forehead, nose, cheek, back, and shoulder, together with the inside of the arm and thigh, and are followed or attended by thin, grayish scales, hard, thick, greenish scabs, narrow, superficial cracks, or well-marked ulcers.

Syphilitic cutaneous diseases can generally be easily distinguished from ordinary skin diseases; first, by the history of the case, especially the existence or absence of chancre; secondly, by the concurrence of lesions of the cutaneous and mucous textures; thirdly, by the copper color of the affected surface, the eruption, scale, or pustule being itself either of that complexion, or surrounded by a more or less distinctly defined border of it; and, lastly, by the total absence of itching in syphilitic affections, whereas that symptom is of very common occurrence in ordinary cutaneous maladies.

1. In the *exanthematous* form, the spots are of a dark copper color, of a circular shape, and from the size of a dime to that of a twenty-five cent piece, the intervening surface being of a muddy, dusky aspect. Although they sometimes cover nearly the whole body, yet they are generally most prominent on the trunk and extremities; they are never confluent, do not disappear under pressure, and usually pass off with a slight desquamation of the cuticle. There is a variety of this eruption in which the spots are of much smaller size, more irregular in shape, and of a brighter red, the color resembling that of a new copper coin. From this circumstance, and from the eruption being often somewhat confluent, like measles, it is generally known by the name of *roseola*. In neither of these forms is there any actual elevation of the skin.

The syphilitic exanthem often comes on before the disappearance of the primary disease, sometimes suddenly, and without any decided premonitory symptoms; at other times gradually, and with considerable pyrexial disturbance. As the eruption fades it loses its reddish tint, and assumes a dingy, dirty, dusky, or grayish aspect. Its duration varies from ten days to three or four weeks. Its gradual disappearance, and its coincidence with chancre, bubo, cervical adenitis, and other marks of syphilis, either primary or secondary, together with the absence of local distress, as itching and smarting, readily distinguish it from measles and other cutaneous affections.

2. The *scaly* variety of syphilis generally appears without any febrile disturbance, from six to ten weeks after the primary disease; it is always remarkably chronic, lasting frequently for months together, and is commonly associated with ulceration of the throat and palate, iritis, and affections of the bones and joints; forming, in this case, a kind of connecting link between the secondary and tertiary stages of the constitutional malady.

The eruption manifests itself, as the name implies, in distinct scales, or thick and hardened portions of epidermis, of a dull, opaque, grayish appearance, resting upon a copper-colored base. It generally appears in separate patches, which, although they may occur on all parts of the cutaneous surface, are, nevertheless, most common on the forehead, scalp, face, forearms, palm of the hand, and sole of the foot, in the latter of which they often acquire a remarkable thickness. Each individual spot is from three to twelve lines in diameter, of a rounded shape, ordinarily isolated, rough, and somewhat elevated beyond the adjoining level. The scale is hard, whitish or grayish, and slightly adherent; the skin underneath has a tendency to ulcerate, or to form cracks and fissures, and when, by this means, its integrity is destroyed, the affected surface becomes covered with a thick, dry, brownish crust. When the part has cicatrized, a whitish spot, somewhat depressed at the centre, marks the original site of the disease.

3. The *vesicular* variety of syphilitic disease is of very uncommon occurrence; it is, in fact, by far the rarest of all the syphilides. It usually begins coincidently with the latter stages of the primary sore, or soon afterwards, in minute, circumscribed pimples, scattered over different parts of the body, to which soon succeed small vesicles, occupied by a transparent, serous fluid, and surrounded by a reddish, copper-colored areola. Their progress is slow, and their contents are either absorbed, or they harden into thin scales, or scabs, which, falling off at different intervals, leave the part of a dingy, yellowish hue. The vesicles, which exist in distinct groups, are occasionally, though rarely, so numerous as to cover nearly the whole surface of the body. In general, they are most common on the neck, chest, and extremities, especially the superior, their occurrence on the face and head being very infrequent. They usually coincide with syphilitic disease of the throat, and nomadic pains in the bones and joints; a circumstance which, together with their copper-colored base, readily distinguishes them from ordinary vesicles.

4. Syphilitic *pustules* consist of circumscribed elevations of the skin, occupied by pus, or sero-purulent matter, and possessing a strong tendency to terminate in ulceration. Although they occasionally co-exist with the primary disease, they seldom appear until a long time after, and therefore generally appertain to the third order of symptoms, their presence being always denotive of profound constitutional contamination. Their size and figure are subject to considerable diversity. Sometimes they are as large as a hazel-nut; but ordinarily they do not exceed the volume of a pea, and in many cases they do not attain even that size. In their shape they are conical, oval, pyriform, rounded, or flattened, with a minute central depression; and there are few instances in which these different varieties do not co-exist. Their number is often immense, hundreds being scattered over a small extent of surface; and, as they form successively, they may be seen and studied in every stage of their development. Each pustule reposes upon a hard, copper-colored base, and is apparently of a very complex structure, though its precise character is undetermined.

After remaining for a short time, the contents of the pustule escape, concrete, and form hard, thick scabs, of a dark color, pretty firmly adherent, and sometimes circularly furrowed. In the more simple cases, the scabs soon fall off, leaving merely a chronic induration, a livid, dusky, or grayish stain, or a small cicatrice; in the more severe forms of the disease, on the contrary, deep, circular, characteristic ulcers are exposed, with a foul, grayish bottom, and a hard, purple, and well defined margin. In cases of the latter description, the scabs are frequently renewed, and are finally succeeded by round, indelible scars.

There are two varieties of syphilitic pustules, the one, termed the psydracious, occurring in groups, and the other, the phlyzacions, disposed separately, without any tendency, as is sometimes the case with the other, to become confluent. Willan and some other dermatologists have described them under the generic appellation of syphilitic ecthyma. It is the matter furnished by these pustules that has been erroneously supposed by Vidal, Cazenave, and a few other observers, to be capable of transmitting secondary syphilis by inoculation.

The pustular form of syphilis is not unfrequently associated with the tubercular and papular, but rarely with the roseolar and squamous. Severe constitutional disturbance is generally present, and, indeed, the suffering may be so great as to destroy life, the health being gradually undermined by the excessive pain and irritation of the eruption and its sequelæ.

5. In the *tubercular* variety of syphilis, the most formidable, if not also the most frequent of all, the eruption consists of small, red, copper-colored eminences, varying in size between that of a mustard-seed and an olive. Of a rounded, flattened, or conoidal shape, they are either isolated, assembled in groups, or arranged in perfect circles; they are smooth and polished, produce little or no pain, and become covered, in a short time, with a dry, scaly incrustation, which is generally reproduced as fast as it falls off.

In the more aggravated forms of this variety of syphilis, the tubercles are inordinately large, prominent, of a deep violet hue, from three to six lines in length, and encircled by a well-marked, copper-colored areola. After continuing thus for some time, varying from a few months to several years, they inflame, suppurate, and are finally replaced by deep, foul, painful, irregular ulcers, reposing upon a hard, purple base. The thick scab which usually covers these erosions is repeatedly renewed, showing, whenever it is detached, that the sore is extending its ravages. When the tubercles are numerous, the ulcers, running together, often acquire a frightful size, and, on healing, leave disfiguring cicatrices.

6. *Papular* syphilis is characterized by the occurrence of small, hard, solid elevations, containing no fluid, and terminating almost always in desquamation, seldom in ulceration, or in the formation of scabs. There are two varieties of the affection, one of which is acute and primary, the other chronic and secondary.

In the first variety, the eruption appears simultaneously on different regions of the body, and is completed in about forty-eight hours from the time of its invasion. The papulæ are extremely small, disjointed, or grouped, of a red copper color, and of a slightly conical shape, being surrounded, here and there, by violet areolæ, which are often confluent, and give the surface a characteristic yellow tinge. Ulceration rarely attacks these papulæ; they disappear in a short time, and are followed by a furfuraceous desquamation of the cuticle.

In the other variety, the eruption is developed in a slow and successive manner, being announced by small yellow spots, which are particularly numerous on the forehead, scalp, and extremities. The papulæ, which are of a light copper color, are larger than the preceding, flat, of the size of small beans, grouped, and devoid of an areola. In time, the summit of each elevation becomes covered with a dry, grayish pellicle, which is regenerated as fast as it desquamates, until the disease finally entirely subsides. Meanwhile, the skin between the agglomerated papulæ undergoes important changes; it assumes a dingy yellowish color, has a dry, shrivelled aspect, and is the seat of a constant exfoliation of the cuticle.

Treatment.—The treatment of secondary cutaneous syphilis may be divided into common and specific, the first being of a general antiphlogistic character, while the second has for its object the neutralization or destruction of the virus upon whose action the affection more particularly depends, and which, so long as it continues, exposes the system constantly to new outbreaks of the disease. In general, it will be found to be advantageous to begin the treatment with antiphlogistic remedies; for, although they may not always, or perhaps even very frequently, eradicate the poison, yet it is unquestionably true that the salutary impression which they make upon the system, by ridding it of its impurities, and restoring the secretions, greatly paves the way for the more prompt and efficient operation of any specific measures that may afterwards be deemed advisable. A disregard of this rule is probably one of the chief reasons why the mercurial treatment of syphilis is so often followed by severe tertiary symptoms, the system not being properly prepared, by a course of dieting, baths, purgatives, and other remedies, for the reception and beneficial action of the mineral.

Syphilitic fever should be combated upon the same general principles as any other kind of sympathetic fever. If the symptoms run high, as indicated by the state of the pulse and skin, and the patient is young and plethoric, blood may be taken from the arm, and the saline and antimonial mixture be directed, the bowels having been previously opened by a brisk cathartic. The action of the medicine should be promoted with tepid drinks, and, if there be much pain and aching in the back and limbs, a Dover's powder, or an anodyne and diaphoretic draught will probably be necessary. The duration of the fever is usually very short, the disease often yielding to very simple measures.

When eruptions appear upon the skin, the treatment which I usually adopt is the *antimonial*, having found it to answer an excellent purpose in a great majority of the cases of the disease that have fallen under my observation. The quantity of tartar emetic to be given at each dose must vary from the fourth to the eighth of a grain, repeated every three, four, or five hours, according to the influence of the remedy, decided nausea being hardly ever desired. The object is to produce only a sedative and alterant effect. It may be administered by itself, as in the milder forms of secondary cutaneous affections, or be variously combined with other articles, as sulphate of magnesia, when there is constipation, aconite, when there is much arterial excitement, or morphine, when an anodyne and diaphoretic action is desired. The salutary operation of the medicine will be greatly promoted by the daily use of the tepid bath, by diluent drinks, and by the strict observance of the antiphlogistic regimen.

How tartrate of antimony and potassa acts in producing its salutary effects in secondary syphilis of the skin has not been determined. It is not improbable that it may, as mercury is supposed to do, neutralize the poison of the disease, by divesting it of its zymotic qualities; or it may act simply as an eliminator, by furnishing an outlet for the poison through the various emunctories, upon all of which this medicine is known to exert more or less influence.

Tartarized antimony, then, according to my experience, is the great remedy upon which our reliance is mainly to be placed in the treatment of secondary syphilis, especially of the skin, and, also, although in a less degree, of the mucous membrane. If the remedy fail, or the disease prove rebellious, recourse must be had to mercury, given in the same manner, and with the same restrictions, as in the primary form of the disease. The use of the latter medicine may, I am satisfied, be limited to a very narrow circle of cases of secondary syphilis, and it will be found that, whenever it becomes necessary, its action will be immensely promoted by the previous employment of tartar emetic.

3. ALOPECIA.

During the progress of syphilis it occasionally happens that the hair of the scalp falls off, constituting what is technically called alopecia. The accident generally comes on within the first six or eight weeks from the appearance of the primary sore, with which, consequently, it is not unfrequently coincident, and usually occurs in circular disks, of variable size, and of a well-marked copper color, similar to the eruptive syphilides. The affection is commonly partial, showing itself, as just stated, in distinct patches, of which several may exist simultaneously, or as fast as one gets well another may succeed, and thus the affection may proceed until it has travelled over the greater portion of the scalp; or, instead of this, nearly all the bulbs may suffer at once, and the hair drop off in great numbers, leaving the head ultimately nearly completely bare. When the system is, as it were, saturated with the specific virus, not only the hair of the scalp, but also of the beard, the eyebrows, and the rest of the body may drop off. I have seen two well-marked cases of this universal alopecia, both occurring in young men who had been the subject of indurated chancre upon the head of the penis; in one the desquamation was associated with roseola and sore throat, and was never followed by a reproduction of hair anywhere. The patient, after having lingered for several years under the exhausting effects of rupia and nodes, died in a state of marasmus. In the second case, the alopecia was succeeded by syphilitic sarcocele; and in this the hair, in time, was regenerated upon the scalp, although it always remained stunted, and was remarkably coarse, stiff, and sparse.

The first sign of baldness usually consists in a loss of the soft and glossy state of the hair, which becomes dry, stiff, and brittle, breaking off very easily in combing the head. After a little while it is observed to fall off in great abundance; and if the scalp be now examined it will be found to be remarkably harsh and scurfy, and to be covered with muddy, dingy, or dusky, copper-colored blotches, generally of a circular shape, and apparently, though not in reality, somewhat elevated above the adjoining surface. Fever occasionally accompanies the affection; and pains in the bones and joints, apparently of a rheumatic nature, generally characterize the progress of the case. Regeneration of the hair, partial or complete, may usually be expected, even under apparently the most adverse circumstances.

Baldness, as an effect of syphilis, is a grave occurrence, and the practitioner cannot be too eager in his attempts to arrest it. The first thing to be done is to cut off the hair, not too closely, but just sufficiently to admit of the requisite attention to cleanliness and medication. Shaving of the scalp is not necessary in any case, however severe. The treatment, directed more especially to the relief of the diseased hair-bulbs, must be essentially of a stimulating character, the object being to impart tone and vigor to the whole of the affected surface. In the more simple cases mild lotions of alcohol and spirits of hartshorn, eau de Cologne and compound spirits of lavender, or alcohol, glycerin, oil, and tincture of cantharides, either in equal, or in different proportions, may be used, according to the desired strength of the particular preparation. Another excellent wash is a solution of tannin and sulphate of copper in equal parts of spirits of wine and water, six grains of the former, and half a grain of the latter being used to the ounce of fluid. The application should be made twice in the twenty-four hours, the friction being performed with the hand and fingers, and steadily continued until there is a glow upon the surface. The scalp should be washed every morning with warm water and Castile soap, and well combed immediately after to promote cleanliness and dislodge dandriff.

If soreness of the scalp exist, or if there be eruptions, papules, tubercles, or numerous dry and adherent scales, the most eligible application will be a pomade of simple cerate and of the ointment of the nitrate of mercury, in the proportion of seven parts of the former to one of the latter, mixed with a few drops of the oil of jasmine and a little Cologne water, and thoroughly rubbed into the roots of the hair night and morning. Along with these means special attention should be paid to the state of the system, and if the case threatens to be obstinate, or if the alopecia coexist with an indurated, indolent, or badly-healed chancre, measures should be adopted to bring the patient as promptly as possible under the gentle influence of mercury.

4. SYPHILITIC ABSCESSES.

The subcutaneous cellular tissue is occasionally the seat of what might be termed the syphilitic abscess. It belongs to the third order of symptoms, and presents itself as a multiple affection. In the few cases that have fallen under my observation the abscesses were scattered over the body in immense numbers, being particularly abundant on the anterior portion of the trunk and on the inside of the arms and thighs. Their volume varies from that of a currant to that of a pea; they rest upon an indurated base, and are generally grouped rather closely together. Their contents are of a white, yellowish appearance, and of a somewhat tough consistence, partaking very much of the character of a mixture of pus and aplastic matter. The progress of the disease is usually very tardy; the general health is a good deal disordered, and the abscesses are very slow in reaching the surface. In fact, under the use of iodide of potassium and mercury most of them gradually disappear without breaking.

5. CERVICAL ADENITIS.

The posterior cervical ganglions generally suffer at an early period of the constitutional involvement, becoming enlarged and somewhat tender, though never very painful, and rolling, when pressed upon with the finger, like so many little elastic balls under the integuments. The swelling is generally most conspicuous in the glands situated along the upper two-thirds of the posterior border of the sterno-cleido-mastoid muscle, and along the root of the hairy scalp, extending frequently as far outwards as the mastoid process on each side. It is essentially of a chronic nature, often lingering for many weeks, and never terminating in suppuration. Diagnostically considered, this species of adenitis, from the constancy of its presence, is of great value, but from the want of practical tact to detect it, it is extremely liable to be overlooked by the surgeon. The number of glands involved seldom exceeds two or three, and in many cases the disease is apparently limited to a single one. Its occurrence is most common in young subjects, and it occasionally manifests itself at so late a period of the disease that it may then be considered as belonging rather to the tertiary than to the secondary order of symptoms.

Cervical adenitis generally readily disappears under the treatment directed for the relief of other secondary affections. The enlarged glands may be rubbed twice a day with ammoniated liniment, or painted with dilute tincture of iodine. If much induration exist, the most eligible remedy will be gentle mercurial inunction.

6. AFFECTIONS OF THE MUCOUS MEMBRANES.

Secondary syphilis of the mucous membranes generally declares itself within a short time after the cure of the primary sore, and sometimes even before this has completely disappeared; existing at one time in association with secondary affections of the skin, and at another, and perhaps more commonly, independently of them. From four to eight weeks is the average period of the evolution of the disease when it attacks these structures. What strikes one as very remarkable is the extent of surface over which it may spread, there being no visible portion of the mucous membranes where it has not been observed. The parts, however, which are most prone to suffer are the tonsils, palate, pharynx, tongue, cheeks, and lips. It rarely extends into the windpipe. No dissections of a satisfactory nature have been made tending to show that the lining membrane of the stomach and bowels ever participates in the morbid action, but it is certain that well-marked signs of the malady have been repeatedly witnessed at the anus, as high up as the first inch or inch and a half from its verge, and of such a character as to be altogether unmistakable. In the male they sometimes appear upon the foreskin and head of the penis, while in the other sex they are liable to occur upon the vulva, the vagina and uterus. Their presence has not been detected in the respiratory and urinary organs, and is therefore altogether a matter of conjecture, only to be settled by future observation. From the remarkable relations existing between the skin and mucous membranes, and the fact that syphilitic affections of the former are liable to occur in all parts of its extent, it is not improbable that the latter may suffer in the same manner, though perhaps not in an equal degree, some portions almost entirely escaping, while others are peculiarly prone to receive and harbor the specific virus.

Secondary affections of the mucous tissues occur in various forms; at one time, or in one place, as an erythematous disease, at another, as an elevation or tubercle, and again as a distinct ulcer, crack, or fissure; depending, doubtless, upon some peculiar modification of the structure of the suffering part, some change in the action of the poison, or some idiosyncrasy of the individual. In the mouth and throat, where these affections are most common, it is not unusual to notice their coexistence, mere inflammatory redness with or without plastic deposit going on at one point, ulceration at another, and the formation of a tubercle at a third.

Syphilitic *erythema* is observed chiefly in the throat, affecting the arches of the palate, tonsils, uvula, pharynx, and perhaps the root of the tongue. In rare cases it extends to the roof of the mouth. It may present itself as a diffused inflammation, or in the form of distinct patches, generally of a circular or oval figure, and from the size of a gold dollar to that of a twenty-five cent piece, the intervening surface being apparently quite healthy. The color, in the early stage of the disease, resembles that of a new copper coin, but it gradually loses its bright, fiery hue, shading off into dark bronze, in proportion as the morbid action declines. In cases of long standing and unusual severity, the discoloration is of a deep flesh-color and conjoined with marked thickening of the mucous membrane, and a tendency to ulceration. Deposits of lymph are not uncommon upon the inflamed surface, even when the disease is not at all active; occurring in small aphthous-looking specks, in patches of considerable size, or in circular rings, more or less firmly adherent, and of a pale orange tint.

This affection, which bears the closest resemblance to erythema of the skin, generally exists without the consciousness of the patient; there being no soreness in the throat or difficulty of deglutition, and no constitutional disturbance. All is quiet and passive, and the disease is perhaps discovered altogether by accident. It of course denotes only a very slight taint of the system. It is apt to appear within the first four or five weeks after the primary sore, and consequently not unfrequently before this is healed.

Ulcers of the throat assume various appearances, and involve different structures, but particularly the tonsils and the back of the pharynx, affecting these parts either separately or conjointly. They occur principally in two varieties of form, the excavated and superficial.

The excavated ulcer looks, as the name denotes, as if it had been made with a punch, or dug out of the tissues with a sharp instrument. Its edges are steep, everted, and ragged, like those of the Hunterian chancre; and they are surrounded by a hard inflammatory, copper-colored base. The surface is usually incrusted with greenish, muddy, or yellowish lymph, which gives it a foul, unhealthy aspect. The discharge is thin and ichorous. The excavated sore is always most distinctly marked on the tonsils, where it sometimes acquires an immense size, and is generally accompanied by extensive inflammation of the surrounding parts. It is often seen during the progress of the primary disease, especially the indurated chancre, and is liable to be associated with some of the earlier forms of cutaneous eruptions, particularly the exanthematous and scaly.

The superficial ulcer is often multiple, several frequently occurring together, either in close proximity, or scattered over the inflamed surface. Its appearance is either that of an abrasion, or of a cavity with well-defined, ragged edges, rather sharp, and often somewhat undermined; its surface being covered with a white or yellowish tenacious and adherent lymph: the parts around, although red and irritated, are free from induration. The most common sites of this variety of sore, which now and then assumes a serpiginous character, are the arches of the palate, uvula, and pharynx. It generally comes on early after the absorption of the specific virus, and often coexists with the primary sore.

Secondary syphilitic ulcers of the throat are liable to take on phagedenic and gangrenous action, in the same manner as primary sores, and apparently from similar causes, the state of the system and mode of life of the patient mainly contributing to change their character. In consequence of the superaddition of this action, extensive destruction of the soft palate may result, followed by difficulty of deglutition and important alterations of the voice. Ordinary syphilitic ulceration of the throat, even when considerable, is not always attended by well-marked local and constitutional symptoms; the disease, in fact, is often remarkably insidious in its approaches, and may therefore have made great progress before its presence is even suspected. The excavated form of the affection is generally accompanied with extensive swelling, pain and difficulty in swallowing, and more or less febrile disturbance. When the tonsils are the seat of the lesion the tumefaction may be so great as to cause serious obstruction to respiration.

Small ulcers, crevices, and fissures, of a secondary nature, are sometimes met with on the lips, especially at the corners of the mouth, the inside of the cheeks, and the tongue; generally superficial, indisposed to spread, and attended with but little uneasiness and discharge. Occasionally they have abrupt edges and a hardened base. Their diagnosis must necessarily be difficult, the only reliable sign being their co-existence with other marks of syphilis, either primary or consecutive.

Mucous *tubercles* are most commonly found upon the tongue, the lips, and the inside of the cheeks, where they occur as slight elevations of the mucous surface, generally of an irregular oval or elongated shape, and of a whitish hue, as if the secretion of the part had been discolored with nitrate of silver or partially coagulated albumen. Upon taking hold of the swelling with the thumb and finger it is felt to be more or less hard, not unlike an indurated chancre, and is generally quite tolerant of manipulation, even firm pressure rarely causing any decided pain. The size of the spots is variable, ranging from that of a pea up to that of a twenty-five cent piece; they sometimes exist in considerable numbers, and then they occasionally become confluent. If unrestrained, they may give rise to ulceration, generally of a deep, excavated character, the edges of the sore being steep and callous.

This variety of syphilitic affection finds its analogy in the condylomatous excrescences which are so liable to form about the anus and perineum, in consequence of the action of the syphilitic virus. As it usually comes on without any pain, its discovery is often purely accidental. The most reliable diagnostics are the peculiar color and feel of the affected part above referred to, and the coexistence of syphilis in other localities, particularly the throat and skin. Not unfrequently traces of the primary disease will be found either in an open sore, or in the indurated cicatrice of a recently healed chancre.

Treatment.—These mucous affections being all of a kindred character, their treatment must be conducted upon the same general principles. If the patient be at all plethoric, antiphlogistics will probably be necessary, blood being taken either by the lancet or by leeches from the vicinity of the inflamed parts, and the depletion followed by active purgation and the use of the antimonial and saline mixture, rendered anodyne and diaphoretic by the addition, to each dose, of a small quantity of morphia. Light diet and perfect quietude are enjoined. In the milder cases of these diseases the most simple constitutional means will generally suffice, no drain upon the system of any kind being necessary. The most suitable local remedies are nitrate of silver, acid nitrate of mercury, and nitric acid, either pure, or variously diluted, and applied at longer or shorter intervals, according to the exigencies of each particular case. The solid lunar caustic is generally to be preferred when there is no breach of continuity, the affected surface being touched with great care and gentleness once every forty-eight hours, some mildly astringent gargle, or simple mucilaginous fluid, being employed in the intervals. When the part is ulcerated the caustic must be used more boldly, as well as oftener; though, under such circumstances, I usually give a decided preference to the acid nitrate of mercury, applied by means of a stick of soft wood, the end of which, being well rounded off, enables us to deposit just enough and not any too much of the fluid, as is so apt to happen when we employ a mop. Not only the sore but also the inflamed surface around should be treated in this way, and the application, in bad cases, should be regularly repeated every twenty-four hours until there is a very decided improvement in the disease. I have found that hardly any secondary ulcer of the throat, palate, or tongue can withstand such a remedy beyond six or eight days, while in many cases it yields in a much shorter time. As soon as the reparative process begins, the acid is used less frequently and in a more dilute state. When the acid nitrate is not at hand, a good substitute will be furnished by nitric acid.

The gargle which I usually prefer in ulcerated sore throat is the pyroligneous acid, in the proportion of from one to two drachms to half a pint of water, well sweetened with honey, and used five or six times in the twenty-four hours. Weak solutions of subacetate of copper and tannin, of nitric acid, and of chlorinated soda also answer an excellent purpose.

Mucous tubercles generally yield to a few applications of the solid nitrate of silver, aided by astringent gargles, suitable purgation, and light diet. Similar means will usually suffice for the cure of superficial abrasions, excoriations, and fissures of the lips and cheek.

Mercurialization only becomes necessary in particular cases. In general, the remedy is called for when there is an excavated ulcer, or an ulcer possessing an extraordinary degree of indolence, or indolence and induration. The simple, superficial sore rarely requires such a remedy; and it is of course withheld when there is a tendency to phagedena or gangrene in a broken, anemic state of the system. Under such circumstances tonics, a generous diet, and nutritious drinks take the place of the mineral.

SECT. IV.—TERTIARY SYPHILIS.

1. GENERAL CONSIDERATIONS.

When the specific poison has deeply penetrated the system, and become, as it were, inlaid in its different structures, as well as thoroughly commingled with the blood, the effects which it produces constitute what is denominated tertiary syphilis, an order of sequence first distinctly asserted by Ricord, and now generally recognized by surgical teachers. The boundary line, however, between the secondary and tertiary groups of phenomena is not always well defined, the former affections often running, by gradual and insensible gradations, into the latter; an occurrence which cannot be too strongly impressed upon the mind of the reader, on account of its great practical importance. It is generally understood that those symptoms of the disease which show themselves before the fifth or sixth month from the commencement of the primary sore should be classed under the head of "secondary syphilis," while those which come on subsequently, or after this period, are considered as appertaining to the third order of phenomena, or "tertiary syphilis," the average period of their evolution ranging from six to eighteen months, although in very many instances they do not occur until a number of years after the appearance of chancre, or chancre and bubo. Thus, I have repeatedly seen tertiary symptoms manifest themselves, for the first time, from twelve to eighteen years after the primary disease, the poison having lain all this time, like a hidden spark, in the economy. Once fairly roused, however, into activity, it extends through the system with great rapidity, completely overwhelming it in its progress, and exploding, with peculiar force, upon certain tissues, textures, or organs, these structures having apparently a kind of elective affinity for it.

The textures which are particularly prone to suffer in tertiary syphilis are the skin, mucous membranes, periosteum, bones, fibro-cartilages, aponeuroses, tendons, and testicles. All parts of the economy, however, are involved in the contamination, and it is extremely probable that, in the worst cases, hardly any organ or structure entirely escapes. The affections of the internal viscera, however, although alluded to by many of the older syphilographers, have only of late attracted serious attention, and hence the amount and nature of their participation in this poisoning process have not been satisfactorily ascertained. Enough, however, has been determined to produce conviction that the changes in the lungs, brain, heart, liver, and other organs are often of a grave character, liable to be followed by the worst results, because so insidious are their approaches and progress that even their existence is hardly ever suspected during life, to say nothing of the impossibility of arresting them by any known treatment, or combination of remedies. The most common of these internal lesions, which have, strangely enough, been termed secondary, are foul, ragged-looking abscesses, with imperfectly elaborated contents, softening and pulpy degeneration, and tubercular deposits. Attention has not yet been sufficiently directed to the alterations of the ovaries of females who die of tertiary syphilis; but from the resemblance which exists between these organs and the testes, both in structure and function, and from the fact that the latter are so often involved in the disease, it is highly probable that it will be found, as our pathological researches are extended, that they frequently seriously participate in the morbid action.

Tertiary syphilis is not invariably preceded by secondary symptoms; on the contrary, there are many cases where the disease passes directly from the first to the third order of phenomena, the structures usually implicated in the secondary attack escaping entirely. Again, it is well known that tertiary syphilis is not always preceded by bubo.

Tertiary symptoms are most liable to occur in persons of intemperate habits, and of a broken dilapidated constitution, with an impoverished state of the blood. A scrofulous or scorbutic condition of the system also acts as a predisposing cause.

The nature of the chancre doubtless exerts considerable influence upon the production of the disease. Thus, there can be no hesitation in affirming that tertiary syphilis is more apt to follow an indurated than a non-indurated chancre. The duration of the primary disease is also to be taken into the account; it being reasonable to suppose that a chronic chancre, which retains its specific poison, will be more likely to give rise to constitutional syphilis than one that is acute or rapidly healed.

Finally, the occurrence of tertiary symptoms is influenced by the nature of the general treatment. It is well known, as stated elsewhere, that when the primary sore has been treated without mercury there is much less likelihood of the development of remote constitutional symptoms than when this remedy has been used, especially when its effects have been carried to an inordinate extent, as evinced by profuse salivation. The occurrence of tertiary syphilis, under such circumstances, is not only probable, but the chances are that, if it do break out, it will show itself in the very worst form, by establishing a sort of mercurio-syphilitic diathesis, which it is extremely difficult, if not impossible, to eradicate completely from the system.

The immediate development of tertiary syphilis is often remarkably influenced by the habits and state of health of the individual. It is impossible to say how long the specific virus might lie dormant in the system if the subject of it were entirely free from the prejudicial influences of surrounding agents. Exposure to cold is usually accused of being one of the most common exciting causes of the complaint, and yet it is notorious that the inhabitants of the South Sea Islands and other tropical regions are extraordinarily prone to all kinds of constitutional syphilis. There can be no doubt, however, that the poison is often fanned into activity by the hardships of our northern winters and by a residence in damp cellars, or moist, ill-ventilated, underground apartments, especially when this mode of life is conjoined with all kinds of dissipation and intemperance, loss of sleep, and an impoverished diet. Although it is extremely probable that no state of the system, however near it may approach to the normal standard, can ever entirely prevent the development of tertiary syphilis, when once the poison has taken possession of it, yet there can be no doubt that an individual so circumstanced will, other things being equal, be much less likely to suffer than one who is differently situated, or who gives himself up to the unbridled indulgence of his passions.

The matter furnished by ulcers, abscesses, and suppurating surfaces, consequent upon tertiary syphilis, is not inoculable; the specific virus has been completely changed in its properties, and no case has ever occurred where it was capable of infecting the tissues of a healthy person by direct contact. It is also believed that the disease is not hereditarily transmissible; but although this be true in the ordinary sense of the term, yet it is extremely probable that the offspring of such an individual are, if not actually imperfectly developed, naturally predisposed to various kinds of cachectic affections, particularly to scrofula and scurvy, by which life is rendered miserable and often cut off prematurely, the constitution being unable to endure the hardships incident to ordinary pursuits.

The *prognosis* of tertiary syphilis is always grave. Whatever form it may assume, it is extremely difficult to dislodge it effectually from the system, or to effect a radical permanent cure. Relapses are of constant occurrence from the most trivial exposure, or the least disorder of the digestive organs, and few patients, however skilfully they may have been treated, are afterwards ever entirely free from rheumatic pains, proneness to cold, and stiffness of the joints. In fact, although recovery undoubtedly occasionally does take place, yet in most cases the constitution remains in an enfeebled and crippled condition, remarkably subject to attacks of other diseases.

Tertiary syphilis often proves fatal, although not nearly as frequently as prior to the discovery of the use of iodide of potassium, death generally occurring from local irritation and constitutional exhaustion. Many of those who recover are horribly disfigured, some from pock marks, some from the loss of the nose and palate, and some from anchylosis of a joint.

2. SYPHILIS OF THE THROAT AND MOUTH.

Tertiary affections of the throat and mouth are by no means uncommon; they supervene at an indefinite period after chancre, and manifest themselves in characteristic ulcers, which, if permitted to go on, gradually spread to the palate and maxillary bones, which, together with the soft parts, are sometimes destroyed to a most frightful extent, the buccal and nasal cavities being perhaps laid into one immense cavern. In some of these cases large portions of the alveolar process of the maxillary bone are necrosed, followed by the loss of many of the teeth, and a similar fate may be experienced by the ascending process and ungual bone, thus implicating and endangering the lachrymal sac and its canals. The nature of the disease is readily ascertained by ocular inspection and the altered state of the voice.

Tertiary syphilis of the *tongue* generally appears in the form of ulcers, or fissures, the latter of which are sometimes of enormous extent and depth, reaching far into the substance of the organ. Specific ulcers are usually situated upon the side of the tongue, at or near its middle, and exhibit the characteristic features of venereal sores in other structures, having a deep excavated form and a foul surface, with marked induration of the base, the parts feeling, on being pinched, like a mass of fibro-cartilage. Only one such cavity generally exists; when large and irritable, it may give rise to swelling of the lymphatic glands at the base of the jaw. The history of the case, the foul, excavated character of the sore, and the existence of syphilitic disease in the throat, nose, or other parts of the body, will always distinguish the lesion from other affections.

The following case will convey a good idea of syphilitic fissures of the tongue:—Frederick Saxe, a blacksmith, aged twenty-eight years, presented himself at the Clinic of the Jefferson Medical College in July, 1857. His tongue, which was of the natural length and breadth but much increased in thickness, and excessively hard at the sides, especially the left, was covered with numerous fissures, of varying size and depth, overhung by steep indurated edges, which at first sight concealed them almost completely from view. The largest groove, which resembled a deep furrow, extended along the centre of the organ, from a short distance in front of the root to within a few lines of the tip, its depth being nearly half an inch. The bottom of each fissure had a clean, smooth appearance; the mucous membrane of the tongue generally was somewhat redder than natural, but there was an entire absence of pain and even soreness under rough manipulation. The starting point of the disease seemed to have been the throat, which had been inflamed for a long time; the uvula had become elongated, and had been cut off weeks ago. The arches of the palate and tonsils were still a good deal discolored and congested. The tongue had been in its present condition for the last three months, having resisted various kinds of treatment, without the disease apparently manifesting any tendency to spread. A small painful node existed on the right tibia, and there was a vesicular eruption with some itching on the face. The man denied that he had ever had syphilis, but the history of the case and his present condition clearly proved that he was mistaken, or tried to deceive me. He rapidly recovered under the internal use of iodide of potassium with bichloride of mercury, and the local application, every other day, of the solid nitrate of silver.

3. SYPHILIS OF THE NOSE.

Syphilitic disease of the nose, or syphilitic ozæna, as it is occasionally called, is another tertiary symptom, depending upon ulceration of the pituitary membrane, and the several bones of the nasal fossæ, including not unfrequently the proper bones of the nose. The morbid action, which is generally associated with marks of a constitutional taint in other situations, usually sets in at a very remote period after the primary sore, and lingers on obstinately for many years, notwithstanding the best directed efforts to arrest it, until it has caused the most extensive havoc, piece after piece dying and dropping off until every one has disappeared. When the proper nasal bones are involved, the whole organ, bridge, cartilage, and skin, may be destroyed. The disease is attended with an abundant fetid and bloody discharge, and the voice has a peculiar characteristic, muffled twang.

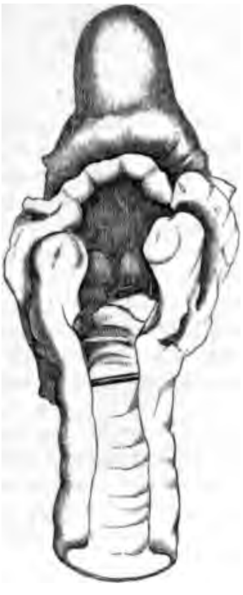
The septum of the nose is very prone to suffer in this form of syphilis, giving way, first, at the cartilaginous structure, and afterwards at the osseous. The consequence is that the part is perforated by an opening of variable size and shape, with sharp, irregular edges, which have a constant tendency to spread until the greater portion of the septum is destroyed. A similar effect sometimes follows scrofula, and considerable difficulty may therefore attend the diagnosis. The chief points of distinction are the history of the case, and the fact that the ulcerative action is generally much more rapid in the former than in the latter disease.

4. SYPHILIS OF THE LARYNX.

Syphilis of the larynx seldom comes on until a long time after the primary disease, and may therefore justly be classed among the tertiary phenomena. In most cases, indeed, it does not declare itself before the end of the second year, and often not until much later. It is generally, but, I think, erroneously ascribed to an extension of disease from the palate, tonsils, and pharynx, by continuity of structure; on the contrary, there is reason to believe that it is usually an independent affection, commencing in the larynx, and thence sometimes passing into the throat. However this may be, its coincidence with syphilis in other parts of the body, particularly of the skin, bones, and fibrous membranes, sufficiently stamps its character, and renders it easy of diagnosis.

The disease, beginning in inflammation, soon terminates in ulceration, which often continues for months and even years together, the erosive action being at one time stationary, or on the very verge of healing, and at another steadily advancing. Confined originally to the mucous membrane, it at length invades the arytenoid cartilages, the vocal cords, and even some of the muscles of the larynx. Portions of the thyroid cartilage occasionally perish, and a not uncommon occurrence is the partial destruction of the epiglottis. In some of the cases of this disease that have come under my observation, nearly the whole of this fibro-cartilage was eaten away, nothing but a thick, narrow, stump-like remnant being left to cover the glottis, as illustrated in fig. 86, from a preparation in my private collection. The cricoid cartilage rarely participates in the disease.

Fig. 86.



Syphilitic ulceration of the larynx.

The ulcers are seldom numerous, unless they are follicular, when the affected surface may literally be studded with them; in general, we do not find more than one or two, which are then pretty large, both as it respects their depth and superficial area. They are of a circular or oval shape, with indurated edges and a foul bottom, and, in the more severe and protracted cases, they sometimes penetrate very deeply, opening, perhaps, externally. Such an occurrence is most likely to happen when there is extensive destruction of the thyroid cartilage.

Occasionally the mucous membrane, instead of being ulcerated, is the seat of granulations, or syphilitic warts, of a red, fleshy appearance, and from the size of a small pin-head to that of a mustard-seed, their number varying from half a dozen to fifteen or twenty; they are usually most conspicuous around the vocal cords, and apparently consist in a hypertrophous condition of the mucous crypts which naturally exist in the interior of the vocal tube.

The symptoms of syphilitic disease of the larynx are generally well marked, particularly when it has made considerable progress, or when it presents itself in the form of ulceration. Besides the wan, emaciated, and cachectic appearance of the patient, which is itself almost sufficient to point out the nature of the affection, there is a hoarse, husky, characteristic state of the voice, which, in time, is reduced to a mere whisper, and eventually completely lost. The larynx feels tender on motion and pressure; deglutition is difficult and painful; and the slightest vocal exertion is productive of severe suffering. Cough is always present, frequently to a most harassing extent; and in attempting to swallow fluids the patient is frequently seized with symptoms of impending suffocation. The matter which is expectorated is excessively fetid, often bloody, and occasionally mixed with fragments of cartilage, its quantity being frequently very copious. As the disease progresses, the local and constitutional irritation increases; the emaciation becomes extreme; the sweats are copious; and the patient at length dies completely exhausted, the immediate cause of his death being, perhaps, inanition, suffocation, or hemorrhage from the sudden giving way of an artery of considerable size. Long before this event, however, the lungs, pleuræ, and bronchial tubes become seriously involved, and thus serve materially to hurry on the fatal crisis.

5. SYPHILIS OF THE EYE.

Iritis belongs to the more advanced stages of syphilis, being usually associated with tubercular, papular, or pustular eruptions, rupial sores, nodes, and rheumatism of the bones, and ulceration of the throat, palate, and nose. It is characterized by a fixed and contracted state of the pupil, which is generally filled with lymph and displaced upward and inward; by the appearance, upon the anterior surface of the iris, of reddish-brown tubercles, or minute yellowish abscesses; and by severe nocturnal pains, situated deep in the eye, forehead and temple. The disease commonly attacks both organs, either simultaneously or successively, and always rapidly extends to the other structures, as the cornea, choroid, and retina, involving them in its ruinous consequences, few persons recovering without loss of sight. As allusion will again be made to this affection in the chapter on the eye, no further notice need here be taken of it.

In April, 1858, Dr. Addinell Hewson read before the Pathological Society of Philadelphia, the history of a case of supposed syphilitic *retinitis*, in a stout man, thirty-one years of age, who had contracted primary syphilis upwards of two years previously. He had subsequently labored under loss of flesh and strength, alopecia, and sores on the skin, afterwards followed by violent pain in the left temple, and dimness of vision in the left eye. There had been no iritis. Under the ophthalmoscope, the lens and vitreous humor appeared to be perfectly clear, but the retina was defective in translucency and of a dirty tint, its surface being extensively sprinkled with small white, yellowish-white, or reddish points, of a globular shape, and strongly resembling the condylomata of syphilitic iritis. The optic nerve was changed in color, and the vessels of the retina were somewhat varicose.

6. SYPHILIS OF THE EAR.

Syphilis of the ear is uncommon. Patients of a broken-down constitution and of intemperate habits are most liable to suffer. The disease frequently comes on in the form of sudden deafness, attended with aching pain, and evidently consists of inflammation of the tympanal membrane, which, upon inspection, is found to be red and abnormally vascular, and, in time, to become more or less opaque. If the morbid action be not soon arrested it may eventuate in ulceration, followed by complete destruction of the membrane, and permanent deafness. In the worst forms of the disease, the Eustachian tube, the middle ear, and even the petrous portion of the temporal bone become involved.

The diagnosis is usually sufficiently easy, the most reliable points being the coexistence of syphilis in other parts of the body, the comparative slightness of the pain, which is much less than in ordinary myringitis, and the amenability of the disease to specific treatment. The affection evidently appertains to the earlier tertiary group.

Syphilis of the ear must be managed upon the same general principles as syphilis of other organs. The great remedies are mercury and potassium, aided by leeches, blisters, and mildly astringent injections.

7. SYPHILIS OF THE SKIN.

Ulcers of the skin, or rupial sores, may be a sequence of secondary syphilis, but in general they are among the more remote effects of the tertiary form of the disease, coming on, in most cases, several years after the primary affection. They usually coexist with nodes and rheumatic pains, or with ulceration of the throat, nose, and larynx, or with all these ailments combined, and are nearly always preceded by scaly eruptions, pustules, papules, or tubercles. Persons of a broken, infirm, and cachectic constitution are their most common subjects, and those in whom they commit the greatest ravages.

Much diversity exists in regard to the situation and character of these cutaneous ulcers. They are most frequently found on the extremities, especially the inferior; they are also sufficiently common on the forearm and elbow, and on the scalp, forehead, and temple. Their size ranges from that of a split pea to that of the crown of a hat, their shape being usually circular or oval, although sometimes it is extremely irregular from two adjoining sores being connected or running into each other. The edges are nearly always callous, everted, and more or less ragged; the surface is excavated, covered with a greenish, pultaceous matter, and exquisitely sensitive; while the discharge, which is often very profuse, is thin, ichorous, and offensive, frequently excessively so. It is not often that we notice anything like a distinct, well-defined areola; such an occurrence is seen only in rare cases, but in most instances there is marked inflammation with redness and induration in the parts immediately around. The largest of these ulcers generally occur on the shoulder, side, and buttock, and it is amazing what an immense size they may attain. Numerous small ulcers of this kind occasionally exist in groups, giving the surface a peculiar worm-eaten appearance. In some cases, again, the ulcers have a serpiginous arrangement; in another class of cases they are, perhaps, very much undermined; and now and then two large ulcers are connected together by a sort of cutaneous bridge. In fact, there is no end to the diversities of their configuration. Finally, they may be quite superficial, or so deep as to involve the subjacent cellular tissue, and even the fasciæ, muscles, tendons, and bones.

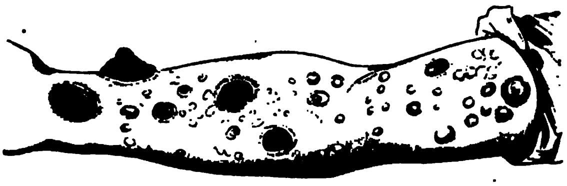
Rupial ulcers often continue for an indefinite period, sometimes partially cicatrizing, now spreading, now indolent or stationary. From local causes, as well as constitutional, they may take on almost any kind of action; when the patient is in an exhausted, irritable condition, they are very apt to become severely inflamed, and to assume a phagedenic, sloughing character, spreading often with immense rapidity, both in diameter and depth. The system generally actively sympathizes with these sores; the skin is dry and hot, the pulse small, quick, and frequent, the appetite impaired, the sleep destroyed, and the loss of flesh and strength excessive. The patient has an old, superannuated, care-worn look, with all the signs of a deep-laid syphilitic cachexia. The scars left by the healing of these ulcers are abnormally white, and retain for a long time a remarkable hardness, with a tendency to constant furfuraceous desquamation. They are sometimes very rough, and prone to reopen from the slightest causes.

The *diagnosis* of syphilitic ulcers is generally sufficiently easy, the only affection with which they are liable to be confounded being the common non-specific sore. There is generally an appearance about a specific ulcer of the skin which at once stamps its character. In the first place, it is generally circular or oval, and of an excavated shape, with hard, everted edges, and a foul surface, destitute of granulations and of healthy discharge; the surrounding surface is indurated, and generally somewhat discolored, the tint often resembling that of copper. Secondly, the sore is often multiple, occurring in groups, and also on different parts of the surface; a circumstance which is generally of itself sufficient to denote its nature; for the ordinary ulcer is usually solitary, and is most common on the lower extremity. Thirdly, the disease of the skin nearly always coexists with syphilitic disease in other structures, especially the periosteum and bones. Finally, the effects of the treatment afford important aid in doubtful cases; ordinary ulcers disappearing, or soon assuming a healthy, granulating appearance, under simple antiphlogistics, rest, and light diet, whereas specific ulcers always require the use of iodide of potassium and mercury, the latter often both internally and externally.

These syphilitic affections of the skin are admirably illustrated in fig. 87. The diagnosis is unmistakable.

The syphilitic eruptions are sometimes attended with *onychia*, or inflammation of the matrix of the nails, the latter of which gradually become dry and black, and eventually drop off, leaving a foul, excavated, painful ulcer, with hard, steep edges, and a very fetid, ichorous discharge. If the morbid action be very severe, or if it be not soon arrested, the matrix will be completely destroyed, when there can of course be no reproduction of the nail; most commonly, however, a part of its substance survives, and afterwards makes a feeble effort at the formation of a new nail, which, in general, however, is merely an ill-shaped, stumpy, horn-like excrescence, altogether different from the original structure. The diagnostic signs of the disease are the copper-colored appearance of the surface immediately around the ulcer, and marks of syphilis in other regions of the body. The lesion occasionally does not appear until may months after the primary sore, thus bringing it, properly speaking, under the head of tertiary symptoms.

Fig. 87.



Syphilitic rupia.

8. SYPHILIS OF THE OSSEOUS SYSTEM.

Affections of the periosteum and bones belong to the latter order of tertiary syphilis, and they may declare themselves in various forms, of which the most important are nodes, or soft tumors, inflammatory hypertrophy, exostosis, caries, and necrosis. These affections may come on at any time after the eighteenth month from the date of the primary sore, but in the great majority of cases they do not show themselves until after the lapse of at least twice that period. They are most liable to occur in persons of a scrofulous and cachectic constitution, and in those whose health has been destroyed by habitual intemperance, constant exposure, and deficient alimentation, leading to an impoverished state of the blood and protracted derangement of the secretions. The idea is now generally prevalent that diseases of the periosteum and bones, especially in their more severe forms, are, in great measure, limited to those persons who have undergone severe courses of mercury for their cure; and in this opinion the results of my experience induce me fully to concur. Of the many cases of tertiary syphilis of the osseous tissue that have fallen under my observation nearly all had taken mercury in large quantity, and the few who had been treated without that remedy had suffered comparatively little, except where there was a marked strumous diathesis, which never fails, I think, to aggravate the effects of the ingrafted disease. It would thus appear, at first sight, that this metal, by combining with the specific poison, was capable of essentially modifying its action, if not of forming a new virus, more potent and destructive than the original. But it is not necessary to have recourse to such an explanation; it is sufficient to know that the action of mercury, when carried to an inordinate extent, is a most powerful depressant, the effect of which is felt, for a long time, by the whole system, by the blood not less than by the solids. A species of physical degradation of the entire organism is thus engendered, which cannot fail to predispose it, in no slight degree, to the injurious operation of morbific agents, whether acting within the system, or impressing it from without, through the medium of the cutaneous and mucous surfaces. Instead, therefore, of supposing that a new poison, or a sort of a syphilitico-mercurial virus, is formed under these circumstances, it will be found to be more in accordance with the established facts of pathology to conclude that the frightful ravages so often committed in tertiary syphilis, after the inordinate use of mercury, upon the osseous tissue, are the result, exclusively, of the deteriorating influence of this metal upon the general system, whereby the more feebly organized structures, as the bones and their investing membrane, are rendered peculiarly prone to a bad form of inflammation, which, if not early checked, often leads to the most serious consequences.

Tertiary syphilis is met with only in certain bones, chiefly in the superficial, or in those least protected by soft parts, as the tibia and fibula, the ulna, clavicle, and bones of the skull, nose, palate, and upper jaw. In rare cases, almost every piece of the skeleton is involved, either simultaneously or successively; some in nodes, some in caries, some in necrosis, and some in exostosis.

Nodes occur chiefly upon the tibia, ulna, and skull, particularly the frontal and parietal bones. They present themselves as circumscribed, semi-solid swellings, of an ovoidal shape, somewhat elastic to the touch, and from half an inch to an inch and a half in diameter. So far as we are able to determine, they always begin beneath the periosteum, upon the surface of the bone, as an inflammation, which is soon followed by the deposition of a remarkably gummy substance, of a light, turbid, or greenish hue, and of the nature of cacoplastic lymph. In many cases this is the only substance found in the swelling; in others, however, it contains, in addition, a considerable quantity of serum or of pus, or the gummy matter may be entirely absent, and the tumor be occupied by an imperfectly elaborated pus. The periosteum and bone, at the seat of the node, are both inflamed, softened, and ulcerated; and as the tumor extends, the superincumbent structures, participating in the morbid action, become red and painful, and ultimately yield at the most prominent point, thus allowing the pent-up fluid an opportunity of escaping, although generally in a very imperfect manner, and not without severe suffering.

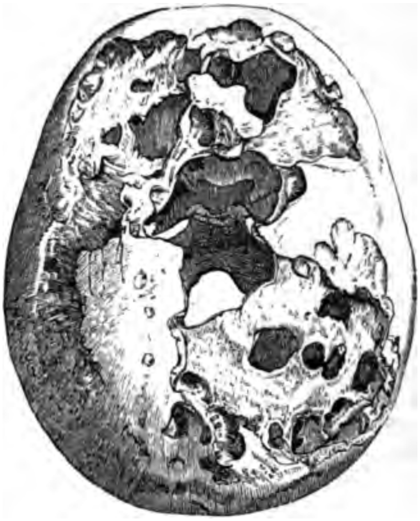
A node is essentially an abscess of the fibrous and osseous tissues, the consequence of a specific inflammation, and occupied by an imperfectly elaborated pus, or a mixture of pus and plasma. Its course is always chronic, and the pain which attends it is peculiar, being of an intermittent, neuralgic character, subject to violent nocturnal exacerbations. The general health is always disordered, and, if the swelling is large, considerable constitutional disturbance is apt to be present. In many cases, nodes co-exist in different pieces of the skeleton. The skull is sometimes studded with them.

A node may not only ulcerate, but also mortify; and after it has become an open sore, it may take on an almost endless variety of morbid actions, incident to syphilis in other structures. Thus, it may be excessively irritable, be invaded by phagedena or gangrene, burrow extensively among the surrounding tissues, be complicated with serious disease of the osseous tissue, or, lastly, be indolent and indisposed to heal.

Caries of the bones is most commonly met with in the long bones of the extremities, as in the tibia and ulna, in the skull, and in the palate, maxillary, nasal, turbinated, and ethmoid bones, together with the vomer; in all of which it is not unfrequently conjoined with *necrosis*, whole pieces dying and sloughing away, so as to cause the most frightful mutilation and disfigurement. These ravages are generally most conspicuous about the countenance, especially when the disease attacks and destroys the proper bones of the nose, which then cave in, and cause that remarkable flattening of the face so characteristic of the effects of tertiary syphilis. In many cases the turbinated bones, the ethmoid, and vomer are separated, so as to convert the nasal fossæ into one immense cavity; and instances occur where, in consequence of the destruction of the palate and maxillary bones, the mouth and nose communicate with each other. In the long bones of the extremities, the caries and necrosis are generally superficial, the dead portions coming away in the form of exfoliations, the central parts of these pieces seldom participating in the morbid action to an extent sufficient to cause their destruction.

The adjoining cut, fig. 88, from Druitt, affords a graphic illustration of caries of the bones of the skull, which, as in a case that came under my observation many years ago, are sometimes completely riddled, so as to give them, throughout, a cribriform appearance.

Fig. 88.

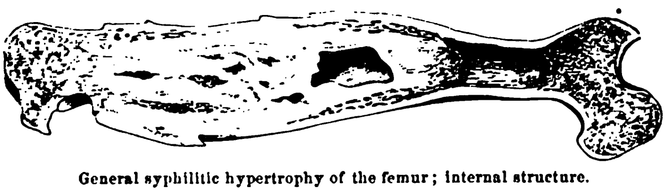


Syphilitic caries of the skull.

Syphilitic *hypertrophy* of the osseous tissue is extremely common, and sometimes involves the greater number of pieces of the skeleton; the bones, however, which are most liable to be attacked are the tibia, fibula, femur, ulna, radius, and cranium. The lesion occurs either as an exostosis, or as a diffused swelling, which, when it affects the whole length and thickness of a bone, assumes the name of general hypertrophy. The mode of formation of a syphilitic exostosis presents nothing peculiar, and need not, therefore, claim any special attention; it evidently takes its rise in a deposit of plasma, which serves as a nidus for the future growth, the ossific process passing through the same phases as in the natural skeleton. The tumor is usually knobby and irregular, with a broad base, and a rough scabrous surface. In cases of long standing, it is nearly always of a hard, ivory consistence.

The more common variety of hypertrophy is the diffused or general, of which the best specimens are usually seen in the bones of the leg, thigh, and forearm, which are often nearly twice the natural thickness and of extraordinary weight and firmness. A section of such a piece, seen in fig. 89, from a specimen in my cabinet, shows that the spongy substance has been completely, or almost completely replaced by solid osseous matter, that the medullary canal has been obliterated, and that the compact structure has acquired a closeness of texture almost equal to that of ivory. The Haversian tubes are for the most part obliterated, or greatly changed in their size and shape, and the outer surface of the bone, as seen in fig. 90, is remarkable for its roughness, its appearance bearing a striking resemblance to that of a worm-eaten tree. The skulls of persons laboring under tertiary syphilis are sometimes astonishingly hypertrophied. In a specimen
me several years ago by Dr. Cochran, of Louisiana, t

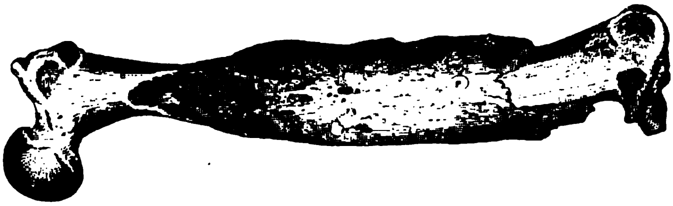
Fig. 89.



General syphilitic hypertrophy of the femur; internal structure.

throughout at least half an inch in thickness; the different pieces are completely fused together without any trace of suture or of diploe, and their consistence and density are almost equal to those of ivory.

Fig. 90.



General syphilitic hypertrophy; external characters.

The *periosteum* is variously affected in syphilitic diseases of the bones; in the more inflammatory lesions it is generally very vascular, soft, and spongy, at the same time that it is considerably thickened, and easily detached from the subjacent surface. In hypertrophy, especially the diffused form, the principal alterations are thickening and induration, with a tendency, here and there, to ossification. Instead of being easily separated from the affected bone, as it is in the more acute affections, the membrane always adheres to it with extraordinary firmness.

The various syphilitic affections of the bones, but especially diffused hypertrophy, are all attended with more or less disturbance of the general health, and deep-seated, excruciating pains. These pains, from the fact that they are always worse at night, have earned for themselves the title of *nocturnal*, although they are rarely entirely absent even in the day; they are also frequently called syphilitic rheumatic pains. They are generally of a dull, heavy, aching, or gnawing character, and begin to increase in severity the moment the patient becomes warm in bed; they may continue all night, or go off in a few hours, but while they last the patient has no sleep or comfort of any kind. Not unfrequently they are of a neuralgic nature; excessively keen, darting, and coming on in nightly paroxysms. While they exist, the affected bones are generally exquisitely tender and intolerant of manipulation.

9. SYPHILITIC ORCHITIS.

Syphilis of the testicle must be classed among the tertiary symptoms, since it rarely comes on until a long time after the primary sore. The average period, in the cases that have fallen under my notice, was from two to four years; but it not unfrequently happens that the enlargement does not show itself until after the lapse of eight, ten, or even twelve years. It is usually associated with syphilis of other parts of the body, particularly the bones, joints, throat, nose and skin, the latter of which is often extensively ulcerated and otherwise disordered. These complications, which are seldom entirely absent in any case of syphilitic orchitis, are especially liable to occur when the tertiary affection breaks out long after the primary one, and they are always denotive of an infirm cachectic state of the system, induced by long suffering, neglect, or bad treatment, or all these causes combined.

The disease almost always involves both testicles, either simultaneously or successively, although seldom in an equal degree; and, as it proceeds, it is sure to extend to the epididymis, so that, in time, the two structures form one inseparable mass. The swelling is characterized by extraordinary weight and hardness, the affected organ resting upon the hand like a heavy solid body, and requiring constant support to prevent it from causing a sense of dragging. When the disease has reached its maximum, the testicle is often six or eight times the normal bulk. The surface of the swelling is variable, though in general it will be found to be rather smooth, or but slightly knobby. The induration is uniform, except when there is, as not unfrequently happens, an accumulation of water in the vaginal tunic, in which case the corresponding portion will be soft and fluctuating. The spermatic cord usually participates in the disease, being unnaturally hard and thickened. When the disease is of long standing, the affected structures lose their normal characters completely, either at particular points, or throughout, the seminiferous substance being replaced by fibrous tissue. In the worst forms of the malady tubercular deposits occur, which, breaking down and disintegrating, lead to the formation of unhealthy abscesses, and, when these discharge their contents, to the establishment of fungus.

Syphilitic sarcocele is always a remarkably tardy and painless disease. It is only, as a general rule, when there is much water in the vaginal tunic, constituting the complication called hydrosarcocele, and causing constant pressure upon the inflamed and degenerating tissues, that the patient will be likely to suffer much, and then chiefly at night and in damp states of the atmosphere. When the swelling is very large, considerable inconvenience is usually experienced from the weight and bulk of the organ. The subjects of this form of syphilis are always thin, pale, and anemic, the appetite is greatly impaired, the strength is wasted, and the sleep is interrupted by nocturnal rheumatism. Their whole appearance, in fact, is indicative of a worn-out, miserable state of the system. When both organs are extensively diseased, the individual must necessarily be impotent. A remarkable feature of this form of syphilis is its tendency to recur, perhaps again and again, after being apparently relieved by treatment.

Syphilitic orchitis can always be easily distinguished from common orchitis; first, by the tardy, indolent, and persistent character of the swelling; secondly, by the simultaneous, or successive involvement of both organs; thirdly, by the co-existence of syphilitic disease in other parts of the body, especially of nodes, and ulcers of the skin, nose, and throat; fourthly, by the gradual but certain destruction of the textures and functions of the testicle; and, lastly, by a careful consideration of the history of the case, particularly of the character of the patient. In obscure cases, before resorting to extirpation, the surgeon should make a faithful trial of anti-syphilitic remedies, otherwise he may have occasion to lament his rashness.

The subjoined case, which I treated at the Clinic of the Jefferson Medical College, in the winter of 1857, affords an excellent idea of the nature, progress, and termination of syphilitic orchitis, with the changes experienced by the affected organ. It was drawn up by Dr. S. W. Gross.

A man, aged 29, had a fungus of the right testicle, which had commenced four months previously, as a small pustule on the scrotum. He had contracted chancre and bubo nine years before, and was laboring at the time of his admission under syphilitic rheumatism, ulceration of the tibia, and a slight eruption upon the face. The right testicle began to enlarge, and to become hard and painful three years ago. The left organ was also diseased, but in a less degree. The general health was much impaired. The fungus, above alluded to, was about the size of a half dollar, and the seat of an offensive, ichorous, and profuse discharge, as well as of severe pain, especially at night. Being satisfied, from a careful examination, that the organ was hopelessly destroyed, I had no hesitation in removing it. The dissection verified the correctness of my diagnosis. The tubular structure was completely annihilated, a fibrous substance, of a pale yellowish color and dense consistence, occupying its place. At the posterior part of the epididymis was an abscess, about the volume of a small hickory-nut, filled with a tough, yellowish, cheesy-looking matter, bearing a close resemblance to tubercular deposit. The wound soon healed, and under the use of iodide of potassium and bichloride of mercury, aided by a nutritious diet, the patient rapidly improved in health and spirits. A year previously to this, I performed a similar operation upon a middle-aged man, who had also labored for a long time under tertiary syphilis. The fungus was of large size, and the testicle was completely degenerated into fibrous tissue. Whenever syphilitic orchitis is of long standing, whether it is accompanied or not by fungus, it will generally be found that its tubular substance is irretrievably destroyed.

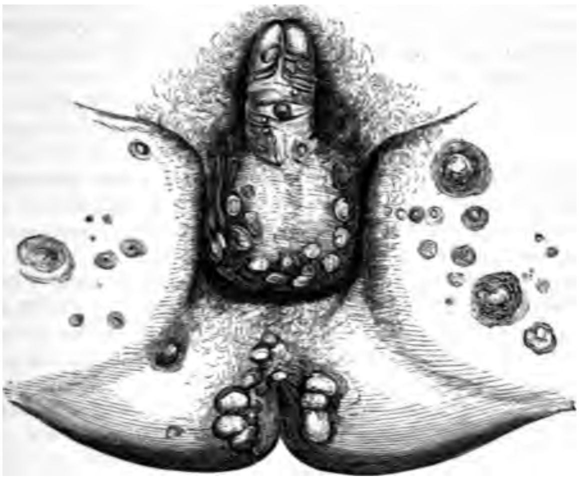
10. CONDYLOMATOUS GROWTHS.

Condylomata of the skin, or of the skin and mucous membrane, usually described by the French syphilographers under the name of mucous tubercles, occasionally arise as a consequence of venereal contamination. They consist in the development of various sized excrescences, of a flat and rather broad appearance, occurring either in groups or in isolated tubercles, and dependent essentially upon a hypertrophied condition of the integuments. It is difficult to assign to this disease its precise rank in the order of syphilitic phenomena, or even to affirm, with certainty, that it is always plainly of a syphilitic character. There are not wanting surgeons of great eminence who do not hesitate to assert that these condylomata may be produced by the contact of gonorrhœal matter, or by acrid vaginal and other secretions not specific in any way. On the other hand, it has been alleged that they pertain, not to one form of syphilis, but to all three, now following chancre, now secondary syphilis, and now tertiary. As for myself, I am inclined to regard them as of a constitutional character, depending upon the absorption of the syphilitic virus, and displaying themselves at a period more or less remote from the primary sore; as belonging, in fact, rather to the third order of phenomena than to the second, and under no circumstances whatever to the first. The idea of the constitutional origin of these bodies is strongly corroborated by the acknowledged fact, that they always require a course of constitutional treatment for their permanent eradication.

These excrescences are sometimes a result of hereditary syphilis. Of this rare occurrence, I have witnessed not less than five cases. The first was a boy, eight years old, whose father had himself had a similar affection several years previously, in consequence of tertiary syphilis, attended with nodes and a scaly eruption. The tubercles existed in great numbers around the anus, and upon the lower part of the perineum, and could not possibly have been better characterized; the child was pale and somewhat emaciated, but there was no other evidence of constitutional contamination. The mother had given birth to three infected infants, two before, and the other at the full period; the former were cast off dead, and in a putrid condition, and the latter died at the age of three months from marasmus, the whole body having been covered with scaly eruptions, which were particularly conspicuous on the forehead, hands, and feet. All the other cases were equally well marked.

The most common sites of condylomata are the scrotum, vulva, perineum, anus, and buttocks, as exhibited in fig. 91. They also occur, though unfrequently, on the penis, and in the folds of the thigh, in the axilla, and in the ear. They seem to have a particular predilection for parts which are habitually hot and moist; for it is there that they are not only most frequently found, but that they acquire their greatest and most rapid development. Their size and shape are very various. Thus, they may not be larger than a pin-head, or a mustard-seed; but on the other hand, they often acquire the volume of a filbert, and even of a small almond. In shape, they are usually flat with a broad base, though not unfrequently the free portion is much larger than the adherent, a circumstance which gives the growths a pediculated aspect. When they occur in groups, as is very apt to be the case, they often coalesce, forming thus considerable masses, tuberculated on the surface, irregular in shape, of a reddish color, and of a firm, fibrous consistence. The largest and worst of these tumors always occur at the margin of the anus, and on the perineum, vulva, and other parts which, from the contact of the opposing surfaces, are habitually subjected to friction, heat, and moisture, which, as already stated, are greatly conducive to their development. In these localities, the tumors are always humid, exhaling a thin, muco-purulent fluid, often quite abundant, and always excessively fetid. In those parts, on the contrary, where they are more exposed to the air, they are dry, insensible, of a darkish color, and partially incrusted with scabs.

Fig. 91.



Condylomata.

Condylomata often coexist with other evidences of a syphilitic taint, especially affections of the bones, rupial sores, tubercles, and scaly eruptions. Their course is variable; sometimes steadily onward, at other times stationary, and now and then even retrogressive. Exercise and friction always irritate them, causing them to become sore, and sometimes so exquisitely sensitive as to deprive the patient of the power of locomotion. When they are large and numerous, the discharge is generally copious and almost insupportably offensive. They are rarely accompanied by febrile symptoms.

It has been supposed that the discharge furnished by these excrescences is contagious, and, consequently, capable, by inoculation, of producing a similar disease. A great deal of plausible testimony has been adduced in favor of this opinion, by surgeons holding the highest position as observers and men of talent; but the notion has always appeared to me to be untenable, on the ground that these bodies, being always the result of a constitutional vice, are not capable of yielding any specific virus. When they coexist with chancre, the occurrence of infection during sexual intercourse is easily explicable.

The diagnosis of condylomata cannot be mistaken. The situation of the excrescences, their peculiar shape, their chronic character, and their fetid secretion all serve to give them a distinctive character. Corroborative testimony is often furnished by the history of the case and the coexistence of syphilis in other parts of the body.

TREATMENT.

The treatment of tertiary syphilis reposes upon broad, scientific, and philosophical principles, and may therefore generally be pursued with a positive certainty of affording great relief, if not of ultimately effecting a radical cure. Even the worst cases may usually be immensely benefited in a very short time under the modern system of treatment; and I have repeatedly seen patients, apparently on the very verge of the grave, who had not enjoyed a comfortable night's sleep for years, and whose bodies had been sadly deformed and racked by pains, raised to health and usefulness by a few doses of medicine. The remedy to which we are indebted for these wonderful effects is the *iodide of potassium*, which, if there be such a medicine as a specific, is unquestionably entitled to that distinction. Experience has shown that it is capable of performing for tertiary syphilis what quinine is for intermittent fever, or arsenic for neuralgia. It is the remedy *par excellence* in tertiary syphilis; a modern discovery of stupendous consequence to the human race; a remedy without which it would be impossible to treat this disease with any prospect whatever of success in almost any case, however simple. Let me not, however, in making these broad statements, be misunderstood. I do not wish to assert that iodide of potassium is absolutely infallible; like quinine and other great remedies, it occasionally disappoints expectation; but we may safely claim for it a degree of certainty which no other article of the materia medica possesses, as an antisyphilitic agent in the tertiary stage of this affection. I therefore ask for it, as has been done by many others, an undoubted confidence in its efficacy, and a fair trial of its use.

The exhibition of iodide of potassium may usually be commenced without any preliminary treatment; it is only when there is great disorder of the secretions that any preparation of the system will be necessary, and then it need not generally extend beyond a single dose of purgative medicine, and the administration of a full anodyne. The proper mode of exhibition is that of solution in distilled water, either alone, or with some bitter infusion or tincture, as hop, gentian, or quassia, such a combination being particularly desirable in the event of a gentle tonic being required. The dose of potassium has been a prolific source of dispute. Long experience has taught me that, while less than ten grains will rarely do much good, there are few cases in which more than this quantity is really ever needed. I have therefore found this to be a good average dose, repeated three times a day, at intervals of eight hours, the most favorable period for the administration being soon after eating. When a rapid effect is required, as when there is unusual urgency of the symptoms, an additional dose may be given, but this will seldom be necessary. I have occasionally exhibited twenty, twenty-five, and even thirty grains at a dose thrice daily, but the effect, instead of being gratifying, has generally disappointed me, the medicine seeming to act as an irritant rather than as a calmative, as it always does when it agrees perfectly with the system. I have never given drachm doses of the article, as is done so often by others, and I should regard such practice as altogether unmeaning, if not positively prejudicial. We cannot take the disease by storm; the treatment must be chronic, in conformity with the malady which it is intended to cure; hence it requires patience, regularity, and perseverance rather than a display of strength and heroism. The remedy must not be abused. The practitioner should be intent upon accomplishing a certain amount of good every day, until he succeeds in eventually expelling the implacable foe effectually from the system. Conducted upon this plan, a most rapid and decided amendment generally occurs; the sleep, appetite, and strength daily improve;

the countenance loses its wan, cachectic appearance; and in less than a fortnight, often indeed in less than a week, the patient looks and acts like a new being, his whole condition, physical and mental, evincing the astonishing change wrought by the medicine.

Iodide of potassium, especially when given in large doses, occasionally signally disagrees with the system, rendering it necessary either to suspend its use altogether, or to administer it in a modified form, or in smaller quantity. The most common effect which it induces is an irritable condition of the air-passages, with a sense of fulness in the head and frontal sinuses, a thin watery discharge from the nose, more or less sneezing, vascular injection of the conjunctiva, and a general feeling of discomfort, the symptoms strongly resembling those of a rather severe coryza. This effect sometimes declares itself after the exhibition of only a few doses of the medicine; at other times it does not appear until after the lapse of eight or ten days, or until the system has been pretty well saturated with it. In some cases, depending evidently upon a strong idiosyncrasy, the smallest quantity almost is sufficient to produce excessive discomfort, and an invincible repugnance to the further use of the remedy. Among the more uncommon effects to which the iodide of potassium may give rise are, gastric irritation, diarrhœa, salivation, glossitis, vesicular eruptions of the skin, excessive diuresis, hemorrhagic discharges from the urethra and vagina, and cerebral excitement not unlike that occasioned by alcoholic drinks.

The best mode of counteracting these disagreeable effects of the medicine is to combine it with an anodyne, as a small quantity of morphia, or from five to ten drops of acetated tincture of opium with each dose. In some cases I have found the free use of strong hop tea to answer the purpose, while in others a mere diminution of the dose was sufficient. I do not remember an instance in which I have been compelled, on this account, to abandon the use of the article altogether.

The length of time during which the potassium should be continued must, of course, vary in different cases and under different circumstances, and does not therefore admit of any definite statement. In the great majority of cases it should be exhibited for many weeks and even for a number of months, with an occasional intermission of three or four days, in order to afford the system a short respite, which is always found eminently beneficial whenever a medicine has to be used chronically. An invariable rule with me is to continue the remedy for several weeks after all disease has apparently vanished; and afterwards to give it for eight or ten days at a time at intervals of a month, on the same principle that we administer quinine periodically and for a long time, for the radical cure of intermittent fever.

Iodide of potassium may sometimes advantageously be combined with carbonate or muriate of ammonia, the two articles being given in solution, in equal proportions, thrice a day. An eminent Italian practitioner, Dr. Gamberini, of Bologna, recommends, as a substitute for iodide of potassium, iodide of sodium and iodide of ammonium. The latter preparation has lately been very frequently employed by Professor Blackman, of Cincinnati, and, as he informs me, with the most gratifying results. He prescribes it in doses of about five grains, three times in the twenty-four hours, using along with it, when there is much emaciation, cod-liver oil and generous diet.

Although I have no hesitation in declaring that iodide of potassium alone will often cure tertiary syphilis, yet I am quite satisfied, from personal experience, that its efficacy is generally remarkably augmented by the addition of a small quantity of *mercury*. Indeed, so thoroughly am I convinced of the decided superiority of this course that I have of late years almost invariably employed it, thus greatly abridging the treatment, and much more completely eradicating the disease. The plan is particularly beneficial when the affection is of long standing, when it has deeply penetrated the system, as shown by the existence of nodes, nocturnal pains, and ulcers upon the skin, and when the patient has been fruitlessly subjected to frequent courses of the iodide alone. An infirm, broken state of the system is no bar to the use of mercury in this mode of combination; on the contrary, it often affords the medicine an opportunity for its best display.

The form of mercury which I prefer, and to which I have become much wedded, is the bichloride, which is readily made soluble by the iodide, and may be given in doses varying from the eighth to the sixteenth of a grain three times a day. I usually begin with the twelfth of a grain, gradually increasing the quantity, if necessary, on account of the obstinacy of the case, to the eighth or sixth of a grain, which should rarely, if ever, be exceeded in any case. The effects of the remedy are of course carefully watched, the slightest tendency to ptyalism being a sign for its suspension, or, at all events, its more guarded use. In general, I have found it beneficial to continue the mineral until there is slight tenderness of the gums, with a metallic taste in the mouth, and to keep up this action afterwards for several weeks by repeating the dose occasionally as the effect begins to flag. In short, chronic mercurialization is wished for, not acute, which never fails to do harm, sometimes immense and irreparable. After the mercurial course has been sufficiently persisted in, the cure may be completed by the iodide of potassium, now given by itself, and perhaps in reduced doses, simply to maintain a slight constitutional impression.

When the bichloride disagrees, which, however, is seldom the case, a good substitute, although of inferior value, will be found in the blue mass, the gray powder, or the protiodide. Donovan's solution, a compound of mercury, iodine, and arsenic, may sometimes be advantageously exhibited, the dose being from six to eight drops three times a day. It often proves serviceable in relieving rheumatic pains and swellings of the bones and periosteum. When the system is much dilapidated, the object is best attained by inunction, fumigation, or the vapor bath, the remedy, when thus introduced, acting often much more beneficially and kindly than when administered by the mouth.

The topical application of mercury is particularly to be commended when the syphilitic disease is of unusually long standing; when the surface is covered with irritable, painful, and intractable sores; when there is deep involvement of the bones, as declared by the existence of nodes, diffused swellings, or caries and necrosis; or when the system is greatly exhausted by protracted suffering, want, and exposure, or long and injudicious courses of mercury by the mouth. Thus employed, its effects frequently display themselves in the most striking and efficient manner, in the rapid and extraordinary improvement that follows in the character of the several local affections and the condition of the general system.

The article which is usually employed for *inunction* is the simple mercurial ointment, from a drachm to a drachm and a half being rubbed upon the inside of the thighs and arms once a day until the constitutional effects of the medicine become apparent by the state of the gums, breath, and saliva. I usually add a small quantity of powdered camphor, with a view of rendering the ointment more soluble, and thereby facilitating its introduction into the skin. The friction should be very thorough, and be continued until the ointment has disappeared from the surface.

Mercurial *fumigations* may be conducted in a very simple manner, and with hardly any expense. All that is necessary is a large comfort, long enough to extend from the floor to the patient's neck, to which it is carefully secured with a piece of tape, so as to prevent the fumes from escaping into the room and entering the sufferer's lungs. For want of this precaution, suffocation has occasionally occurred, as in an instance which took place, many years ago, at the Louisville Hospital, in a man affected with tertiary syphilis. Or, instead of this, the body may be surrounded with a cloak of oil-cloth. The patient, completely stripped, is seated in a large arm chair, or upon a stool, beneath which is placed the fumigating apparatus, consisting of a common dinner plate, and a spirit lamp, arranged in such a manner as not to endanger the safety of the person. The mercurial preparation usually employed is the red sulphuret, of which from half a drachm to a drachm is put upon the plate prior to the ignition of the lamp. The operation, which should not be repeated oftener than once a day, lasts from ten to twenty minutes, at the end of which the patient should retire to bed, and cover himself well up in order to maintain the perspiration usually so auspiciously begun during the fumigation. Great prostration, however, may follow this sweating process, and hence care should be taken not to carry it too far, or to renew it too frequently. The length of time during which the fumigation should be continued must depend upon circumstances; in general, it will not be short of two or three weeks.

Another mode of employing mercury topically is by a combination of fumigation with steam, constituting what Mr. Langston Parker, of Manchester, terms the *mercurial vapor bath*. It is applied after the same method as ordinary fumigation, with this difference, that, while the cinnabar or sulphuret is volatilized by means of a spirit lamp, the steam of hot water is conveyed from a boiler under the patient's mantle as he sits in his chair.

I can testify from considerable experience to the beneficial effects of these two methods of mercurialization, having effected some very extraordinary cures with them after all other rational means of treatment had failed. I recollect, in particular, the case of a young gentleman of Arkansas, who was under my charge, in 1855, on account of tertiary syphilis of many years' standing, attended with an enormous amount of rupial action of the skin, one of the sores being fully as large as a dinner plate, and with an infirm, cachectic state of the system, who was promptly cured, comparatively speaking, by daily fumigations with sulphuret of mercury, conjoined with the frequent use of the tepid bath, a nutritious diet, and stimulants, after a great variety of other means had been fruitlessly employed. My impression is that this mode of treatment is not sufficiently appreciated by the profession of this country. It certainly deserves the highest encomiums. When there is much disorder of the secretions, derangement of the alimentary canal, or a feverish state of the system, a short course of preliminary treatment will generally be necessary before commencing the fumigation process, as this will greatly augment its efficacy. In all cases the object should be to bring the mercurial vapor as fully as possible in contact with the syphilitic sores.

Simple and medicated *baths* often prove serviceable in tertiary syphilis, not only as means of cleanliness, but by the direct soothing and healing influence which they exert upon the part and system. They are particularly beneficial in rupial ulcers and in rheumatic pains of the bones and joints. The emollient bath, prepared by mixing a basinful of thick gruel, or twice that quantity of wheat bran, with a suitable quantity of tepid water, generally proves most grateful. The common salt-water bath, or a bath containing a small quantity of carbonate of potassa, or chloride of sodium, is an excellent detergent and stimulant in the foul ulcers of the skin and bones so common in the advanced stages of syphilis. Occasionally the water may be advantageously impregnated with bichloride of mercury, from three to ten grains of the salt being added to the gallon of fluid, and the immersion continued for at least twenty or thirty minutes. Much caution, however, is required, especially when the surface is considerably denuded, otherwise severe ptyalism may arise. Baths containing nitric, hydrochloric, or acetic acid, are sometimes used, though of late they have gone much out of vogue, chiefly, perhaps, because they are inconvenient, and liable, if proper care be not taken in their preparation, to cause severe pain.

Besides mercury and the other means above mentioned, there are certain remedies which, although usually considered as being merely auxiliary, are, nevertheless, of great consequence in a curative point of view in the treatment of syphilis. At the head of these may be placed a properly regulated diet, tonics, sudorifics, and anodynes, which deserve the greatest attention in every case of the disease.

It is impossible to insist too strongly upon a well regulated *diet* in the treatment of this affection, when it is recollected how much its progress and virulence are influenced by the exhausted and impoverished condition of the system which generally attends it in its more advanced stages. No medicine can possibly produce its full and legitimate effects under such circumstances, without the aid of good, wholesome, and easily digestible food, stimulating drinks, especially brandy and whisky, and an abundance of fresh air. The blood must be enriched and the solids rebuilt before it will be possible to eradicate the specific virus from the system.

Tonics are nearly always indicated; and quinine with iron will usually be found to answer better than any other combination. The bitter extracts, as gentian and quassia, are generally of no account, except in so far as they may conduce to improve the appetite. Occasionally benefit accrues from the use of some of the acids, particularly the nitric and hydrochloric, either alone or conjointly, and diluted with a large quantity of water. Formerly, powerful anti-syphilitic properties were ascribed to these articles, but it is probable that all the good they do is solely dependent upon their tonic virtues, and not upon any agency they possess in neutralizing the syphilitic poison. When much emaciation exists, with want of assimilative power, or a feeble digestion, there is no article which holds out greater promise of usefulness than cod-liver oil, given in doses suited to the state of the stomach and the general condition of the system.

Sudorifics have long held a high rank in the treatment of syphilitic affections, under a supposition, at one time quite rife, that they aided in carrying off the venereal poison, thus ridding the system of its noxious influence. Without conceding to them such a virtue, which they certainly do not possess, there is no question as to their general usefulness in all states of the economy attended with obstructed perspiration, so often present in the advanced stages of syphilis, particularly when there is serious involvement of the skin. The object for which such medicines are usually prescribed may be readily obtained by the warm, hot, or steam bath, assisted by tepid drinks, and various kinds of diaphoretics, as Dover's powder, antimony and morphia, and similar articles. Some caution is necessary in the use of sudorifics, lest injurious debility be induced.

But of all the auxiliary remedies now described, the most important, in every respect, are *anodynes;* their employment is absolutely indispensable, and it is therefore impossible to assign to them too high a rank. They are, up to a certain stage of the treatment, of more consequence even than food and drink. The patient is not only not able to sleep, but his body is literally racked with pain and surcharged with irritability. To look for any substantial improvement, under such circumstances, from ordinary remedies, would be worse than idle; it would be absurd. The first thing to be done is to quiet the system and induce sleep; and to accomplish this, anodynes must be exhibited in large and sustained doses, a grain of morphia, or its equivalent of solid opium, laudanum, or black drop being given every eight or twelve hours, according to the effects of the article. The manner in which anodynes are borne, in the worst forms of tertiary syphilis, is often astonishing, and can only be explained by the irritable condition of the nervous system.

I have not made any reference to *sarsaparilla* in the enumeration of the above remedies, simply because I am not sure that its employment in my hands has ever been productive of any appreciable benefit. Whether this has arisen from bad luck, or from the use of an inferior article, it is not in my power to affirm; I may state, however, that I have employed it in every form and mode of combination in which it is used in this and other countries, and am therefore inclined to believe that it has been invested with virtues which do not belong to it, or which are due mainly, if not solely, to its associate ingredients.

Finally, persons laboring under tertiary syphilis should live in a pure, dry atmosphere, and be well protected against cold. When it is remembered how easily the disease is provoked by exposure to cold, and by living in damp, underground, and ill-ventilated apartments, the importance of attention to this injunction cannot fail to be fully appreciated. The body should be well covered with flannel, both in summer and winter, and the patient should not be permitted to sit in the draught.

The above general treatment is applicable, to a greater or less extent, to all forms and cases of tertiary syphilis whatever; it is only necessary, therefore, in concluding this branch of the subject, to refer to the topical measures, and to such modifications of treatment as are likely to grow out of the anatomical relations of the individual structures and organs liable to suffer from this disease.

There are certain rules of treatment which are applicable to all local affections, whatever may be their site or extent. Thus, the surgeon does not hesitate to remove dead bone, open abscesses, trace out sinuses, divide fasciæ or aponeuroses, and trim off the ragged, undermined and impoverished edges of cutaneous ulcers, so as to place them in a more suitable condition for speedy reparation. All this is self-evident, and only requires mention to secure attention. Cleanliness is of paramount importance in all cases, as it contributes not merely to personal comfort, but also, in a powerful degree, to recovery. Fetor is allayed by the free use of the chlorides.

Ulcers, fissures, eruptions, papules, and tubercles of the *skin* often get well with very little topical treatment; simply, in fact, under the use of iodide of potassium, or potassium and mercury, with attention to cleanliness and other hygienic observances. When much inflammation is present, with a foul appearance of the part and a tendency to spread, the dilute tincture of iodine will come in play, with emollient cataplasms, or the warm water-dressing, simple or medicated. Touching the sores lightly once a day, or every other day, with dilute acid nitrate of mercury or the solid nitrate of silver, generally astonishingly promotes the cure. Unguents are not always as bad as they have been represented to be in these cases. I have often employed them with excellent effect, especially the opiate cerate, the balsam of Peru ointment, and the ointment of the nitrate of mercury, mixed with six or eight times its bulk of simple cerate. The mercurial ointment, much diluted, and mixed with opium, often makes an excellent dressing in the indolent form of rupial ulcer.

Syphilitic *onychia* is, strictly speaking, a rupial ulcer, and should therefore be treated in the same manner as similar sores elsewhere. If abscesses form under the nail, they must be punctured; and if the nail die, it must be removed, or trimmed, if it overhang and injuriously compress the diseased parts.

The topical treatment of tertiary ulcers of the *throat*, mouth, and tongue is restricted principally to applications of the acid nitrate of mercury and solid nitrate of silver, made at first once a day, and subsequently every third, or fourth day, according to the condition and progress of the sore. Weak gargles, or washes of acetic acid, tannin and sulphate of copper, chlorinated soda, or of the cyanuret of mercury, in the proportion of from ten to sixteen grains of the salt to a pint of some bland, mucilaginous fluid, as linseed tea or infusion of elm bark, may be employed three or four times a day in the intervals.

In the treatment of syphilis of the *nose*, our chief reliance is upon injections of weak lotions of iodide of iron, sulphate of copper and tannin, tincture of myrrh, and chlorinated soda, particularly the latter, as it imparts not only a healthy stimulus to the affected surfaces, but effectually allays fetor, so distressing and disgusting in this class of nasal complaints. Mercurial preparations are, as a general rule, improper, being extremely prone to pass into the stomach, and thus occasion salivation; but for this they would often be most beneficial. In using injections for the nose, a large syringe with a long, perforated nozzle is required, the object being to bring the fluid in contact with every portion of diseased structure. They should not be repeated more frequently than thrice a day, and especial care must be taken that they do not distress by their severity. In fact, an injection of the nose should never smart beyond a very few minutes, and then only in a very slight degree. If it pains longer, it is an evidence that it is too severe to be beneficial.

If the affected parts are within reach, regular and steady medication may be effected with lint smeared with some suitable ointment or wet with some slightly stimulating lotion. In all cases the nasal cavities should be frequently inspected with a view to the early detection and removal of dead bone.

In syphilis of the *larynx* direct medication may be attempted by means of the mop wet with a weak solution—from ten to twenty grains to the ounce—of nitrate of silver, introduced once every third or fourth day, the patient being at the moment partially under the influence of chloroform so as to render the parts more passive, and, consequently, more tolerant of the operation, which is otherwise very apt to prove a complete failure. When the disease is extensive or the case urgent, as when there is deep ulceration with excessive difficulty of deglutition and frequent spasm of the muscles, or œdema of the glottis, nothing short of laryngotomy will suffice, and should be had recourse to without delay. Direct medication may then be made with acid nitrate of mercury or with any other article that may seem expedient. If warty excrescences be present, they may be clipped off with the scissors, repullulation being prevented by escharotics or sorbefacients. Dead cartilage is removed in the usual way.

The great remedy for syphilitic *iritis* is mercury pushed in such a manner as to produce a most rapid and decidedly salivant effect. No time is to be lost; the treatment must be prompt and earnest, with a view to the one result, or the eye is lost. If the patient be young or plethoric, blood is freely taken from the arm or by leeches and cups from the temple. Opium is given to allay pain and prevent the mercury from running off by the bowels.

Affections of the *bones* and periosteum of the extremities are treated upon general antiphlogistic principles. The local pain and swelling are often immensely benefited by tincture of iodine, leeches, and blisters, although in very many instances they readily yield to the internal exhibition of iodide of potassium and mercury. A node should not, as a general rule, be opened so long as it is very small, and unproductive of serious annoyance; when the reverse, however, is the case, it should be freely incised, and so also if it be the seat of distinct fluctuation, denotive of the existence of matter. A good rule, under such circumstances, is to make the knife graze the bone, imperfect division of the parts being generally worse than useless. If the resulting ulcer be slow in healing, it should be well blistered, or dressed with mercurial ointment, or some stimulating and anodyne lotion. Sometimes the pain and tension of a node may be promptly relieved by subcutaneous incision, effected by means of a delicate bistoury, carried about in different directions and in such a manner as also to divide the periosteum. Necrosed bone must be removed as soon as it is sufficiently detached to admit of its easy separation; while carious bone must be scraped and otherwise managed to put it in a condition capable of undergoing reparation. Diffused hypertrophy rarely requires any other than constitutional remedies. Exostosis, properly so called, is usually free from mechanical inconvenience; should it act obstructingly, the best remedy will be the saw or pliers.

Syphilitic *sarcocele* is treated, topically speaking, upon the same general principles as swelling of the testicle from gonorrhœa, by rest of body and elevation of part, leeches, astringent and anodyne fomentations, and mild mercurial inunctions. When the enlargement is indolent and rebellious, strapping may be employed, either with common adhesive plaster, mercurial and ammoniac plaster, or the plaster of Vigo. The cure is often retarded in these cases by the presence of a considerable quantity of serum in the vaginal tunic, compressing and irritating the diseased organ. The proper remedy is a free incision, or repeated punctures. If abscesses and fungus form, they should be treated in the ordinary manner.

When the testicle is fungous, ulcerated, and completely disorganized, the only resource is removal, no treatment, either general or local, proving of any service in such a case. But, before so serious an operation is ventured upon, it should always be understood that the organ is really, and not merely apparently, past recovery.

The treatment of *condylomatous* growths must be conducted upon general and local principles. It is true, topical means alone will often cure them without difficulty; but to effect permanent riddance constitutional treatment is generally indispensable. The most efficacious remedy, for this purpose, is the iodide of potassium in union with the bichloride of mercury, administered as in tertiary syphilis, the diet, bowels, and secretions being at the same time suitably regulated. The specific treatment should be prolonged, in a modified manner, for several weeks after all disease has apparently disappeared, the object being to break up all tendency to recurrence.

In regard to the topical treatment, cleanliness is a matter of primary importance, hardly less on account of the attendants than of the patient himself. Free use must be made of tepid water, impregnated with the liquid chlorinated soda, and applied by means of a sponge or syringe; if there be much discharge, the dressings and the bedclothes should be frequently sprinkled with the solution. Another important element of treatment is perfect rest with isolation of the affected parts, their contact having, as stated previously, a tendency to foster growth and secretion. To repress the tumors, various remedies may be used, the best of which is chromic acid, applied once in the twenty-four hours, until they are shrivelled and dried up, as they generally will be in a few days. Nitrate of silver, nitric acid, and acid nitrate of mercury, so commonly recommended, are all extremely severe, besides being very uncertain. In the intervals of the applications, the excrescences should be kept well covered with some desiccating substance, such as three parts of prepared chalk to one of carbonate of zinc, calomel, or dry lint. Under this management rapid improvement soon follows; the tubercles becoming dry, shrivelled, and less sensitive. In the minor cases, prompt relief generally follows the application, several times a day, of pulverized savin, with a small quantity of tannin and a minute portion of sulphate of copper, or equal parts of powdered savin and alum. Great attention should be bestowed upon cleanliness for a long time after the excrescences have disappeared.

SYPHILIS IN THE INFANT.

Infants are subject to syphilis, and there are two modes in which they may become infected. First, they may suffer from direct inoculation, and, secondly, the disease may be communicated by either parent; by the father in the act of copulation, or by the mother during the process of pregnancy. It has also been supposed that a child may be contaminated by the milk of an unsound nurse, but if this be true, the facts have not been presented in such a light as to induce general conviction of their accuracy.

Direct, primary syphilis may be contracted, as, indeed, it most generally is, by a child in its passage through the soft parts of the mother, by the surface of the body coming in immediate contact with a chancre in the vagina, or on the vulva, or, at all events, with the secretions of such a sore. In this manner an eye may become inoculated, or the mouth, or, in short, any mucous surface that may entangle and retain the specific virus sufficiently long to admit of its absorption; for in so young a subject as this it is probably not necessary that there should be any actual solution of continuity in order to produce the effect, the mucous tissues being so delicate, and the lymphatics so active as to enable the poison to enter these vessels by direct imbibition. When the disease attacks the skin, however, it is generally, if not always, the result of direct inoculation from the matter being brought into contact with an abrasion on its surface. A nurse having a chancre upon her nipple may impart the virus to the infant's lips in the act of suckling, but such an occurrence, although possible, must be extremely uncommon.

In whatever manner the infection is caught, the resulting disease pursues the same course as when it occurs in the adult, whether from sexual intercourse or artificial inoculation. The child may perish from the local irritation, or, if it survive the primary affection, it may afterwards suffer from constitutional syphilis, the impression manifesting itself in cutaneous eruptions, mucous tubercles, sore throat, ulceration of the nose, and rheumatic pains in the bones and joints.

In the great majority of cases of infantile syphilis, however, the disease is communicated either through the seminal fluid of the father, in the act of procreation, or by the mother through her blood after the ovum has taken up its residence in the uterus. That the contamination may occur in both these ways has been incontestably proved by numerous observations, conducted with such care as not to admit of any reasonable doubt. The semen is a living fluid, and in a man laboring under constitutional syphilis the probability is that every spermatozoon is completely impregnated with the specific poison; hence it is only necessary that it should be mixed with the material furnished by the mother in order to produce thorough vitiation of the new being. Thus, the very fountain of life is poisoned in the very act of conception, and it is therefore not surprising that all its sources should participate in the evil thus inflicted.

The time at which a female with secondary symptoms may communicate the poison to her offspring cannot be accurately stated. The probability is that it is very short. This is proved by the circumstance that such a woman frequently aborts within a few months after conception, evidently in consequence of the deleterious effects of the virus upon the fœtus. I suppose that the contamination is coeval with conception, occurring at the moment of the commingling of the two seminal fluids; for if it be assumed, as we have a right to do from the facts of the case, that the male can communicate the poison in this manner, why should a similar faculty not be ascribed to the female? She, too, furnishes a fecundating substance—a seminal liquor—

which can no more escape contamination when her system is affected with secondary syphilis than the seminal fluid of the male. In both cases, the blood, the source of life, growth, and nutrition, is completely empoisoned, and hence all its products, whether solid or fluid, must necessarily participate in the evil effects to which such a state must give rise. But in the female these effects must be still greater than in the male; the whole function of the male, in the process of reproduction, consists in the deposition of a certain amount of semen, perhaps a solitary spermatozoon, while the female is also obliged not only to furnish a fluid, but after conception has occurred, she is compelled to nourish the new being, the most intimate connection being established between them by means of the placenta.

It has been alleged that a healthy child, or a child born of healthy parents, may be infected by a nurse affected with secondary syphilis; the milk being tainted, and capable of communicating the disease. Of the possibility of such an occurrence I entertain, I confess, great doubt; my own practice has certainly not afforded me any examples of it, while it has fallen to my lot to see several cases where the converse was the fact, healthy children having sucked infected women, and yet they remained perfectly sound.

It has been a contested point whether a child, laboring under constitutional syphilis, can infect its nurse by communicating the disease through the nipple, and the question, as might have been expected, has been answered differently by different writers. Those who have espoused the affirmative side of the question, rest their assertion upon the result of personal observation, the most reliable testimony of all, one would suppose, in a controversy of this kind; but it is not to be forgotten that observation is fallacious, and that all men, however competent to practise medicine and surgery, are liable to be deceived by their patients, especially in relation to venereal affections. Not only do the abettors of this doctrine assert the possibility of this mode of transmission, but they go further and allege that a nurse so affected has, in turn, infected her own offspring. In a case related by Mr. Hunter, and upon which great stress is usually laid by authors, it is stated that the diseased infant, in this way, successively inoculated three wet nurses, two of whom afterwards conceived, and were delivered of syphilitic children. Now, instead of looking upon this case in this peculiar light, I should be inclined to infer one of two things, either that this diseased child had had a chancre upon its lip, or, what is more probable, that the three nurses had all been previously infected.

Those, on the other hand, who contend that such a mode of contamination is impracticable, base their conclusions upon the fact that the matter of secondary syphilis is destitute of inoculable properties, no well authenticated case, or one entirely free from objection, having yet been observed of the transmission of the disease through its intervention. Now, if this be true, as undoubtedly it is of the adult, it ought to be equally true of the infant; and hence, although the child should have a specific sore upon the lip or tongue, and the mother a fissure, crack, or ulcer upon the nipple, yet, inasmuch as the secretion of the former is innocuous, no constitutional contamination can be caused by its contact with the exposed surface of the latter.

There is another question which closely connects itself with the preceding, and it is this: Is there any evidence, of a positive kind, that a husband laboring under secondary syphilis may communicate the disease to his wife through the agency of the semen? So far as I am aware, there is none, and yet the affirmative side of the question has met with some very warm advocates. It is absurd to believe that this fluid, when injected into the vagina and uterus, is ever absorbed, even supposing that it were retained for a considerable length of time, which, however, it rarely, if ever, is. There is certainly no satisfactory proof of such an event, and we must, therefore, at least for the present, reject it. It is different when impregnation occurs. Here, as already seen, the semen mixes directly with the corresponding fluid of the female, to which it at once imparts its deleterious properties, thereby effectually tainting the new being in the very act of its creation.

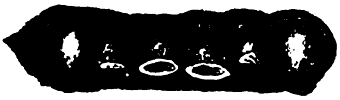
Hereditary syphilis is generally a grave disease; for, unless it be judiciously treated, it nearly always proves fatal. A great majority of the neglected cases terminate in abortion, the fœtus often perishing as early as the end of the third month, and from thence on death may occur at any period up to the full term of gestation, the child being usually thrown off in a putrid and horribly offensive condition. The number of successive abortions is sometimes remarkable; in one instance, communicated to me by one of my own patients, it amounted to thirteen, the woman never having brought forth a healthy infant. Cases of three and four successive abortions have repeatedly come under my observation. Now and then a woman will abort several times in succession, and then be delivered of an apparently healthy child; I say apparently healthy, for, although the new being may be perfectly plump and fat, and exhibit all the outward signs of the most perfect integrity, yet generally, in a very few weeks, it is found to present unmistakable marks of decay and disease. The first thing that is usually noticed is that it loses flesh and strength, becoming gradually thin and puling, and looking as if it had been withered by the sudden drying up of its juices. The skin has a dingy, muddy, shrivelled appearance, and hangs about in loose, soft folds. The countenance is shrunken, wan, and ghastly, and resembles that of a man of seventy-five or eighty, instead of that of an infant a few weeks old. The voice is husky; the respiration is snuffling; the throat is sore; the gums are red and spongy; the lips and anus are fissured; and the body is covered with copper-colored eruptions, usually of the scaly kind, and intermixed with tubercles. Purulent ophthalmia is not uncommon, the inflammation usually coming on within two or three days after birth, and generally ending in total blindness. In some cases numerous superficial ulcers are found upon the surface, attended with a thick, tenacious discharge, and a hard, reddish, characteristic base. The hair often drops off in large quantity, both on the scalp and on the rest of the body. The well-developed node and orchitis are of rare occurrence in infantile syphilis. Death, under such circumstances, is seldom protracted beyond the first three or four weeks after birth. Occasionally, the child may reach the end of the second or third year, and in a few instances life is prolonged until after the period of puberty, the individual having a stunted, sickly growth, and being the subject of deep ulcerations of the throat, palate, nose, and skin, with, perhaps, caries of the bones of the extremities, and stiffness of some of the principal joints. Such, in a few words, is an account of the most common effects of this direful form of the disease. Few children recover, and those who do are doomed to drag out a miserable existence, generally amidst the most loathsome and disgusting deformities.

Infantile syphilitic eruptions are liable to be mistaken for some of the more common affections of the skin incident to early childhood, and the *diagnosis* is not unfrequently environed with no little difficulty in consequence. In obscure cases, our chief reliance is to be placed upon the history of the attack, and other concomitant circumstances. From three to four weeks after birth is the average period of the appearance of the cutaneous affections, the sole of the foot, the buttock, scrotum, face, chest, and inside of the thigh and arm being the parts originally involved. The surface immediately around the eruptions is of a coppery or reddish-brown color, a condition very different from what is observed in ordinary diseases, especially eczema, lichen, prurigo, and lepra, with which they are most liable to be confounded. Besides this, which is always a most important symptom, diagnostically considered, the general appearance of the infant shows that it has received a severe shock; it is thin and emaciated, and progressively fails to an extent, and in a manner altogether unusual in common cutaneous maladies. The old, withered and shrivelled look of the child is almost, of itself, characteristic of the disease; the snuffling is another important element in the discrimination of the case, and too much stress cannot be laid upon the mottled, dingy, or muddy state of the skin. The history of the case will usually show that the parents have been the subjects of syphilis, or that they are actually suffering under it at the time.

Much stress has recently been laid upon the condition of the teeth as a diagnostic sign in hereditary infantile syphilis, attention having been first directed to the subject by Mr. J. Hutchinson, of England. The disease occurs chiefly in connection with, or as a result of, specific stomatitis, and displays itself more particularly in the upper incisors, although the lower incisors and even the canine teeth occasionally participate in the morbid action. The first evidence of the disease is generally a dirty, dingy or light brownish appearance of the enamel of the central and afterwards of the lateral incisors, which soon begin to soften and crumble away, the child ultimately becoming edentulous. Both sets of teeth are cut prematurely as well as very irregularly, as it respects their position in the jaw; and, unless the constitutional taint is early eradicated, the permanent are doomed to share the same fate as the temporary, although they are destroyed less rapidly.

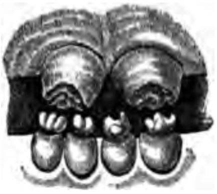
The characteristic appearances of infantile syphilitic teeth are well illustrated in the annexed sketches, figs. 92, 93, borrowed from Mr. Erichsen.

Fig. 92.



Syphilitic temporary teeth.

Fig. 93.



Syphilitic permanent teeth.

Treatment.—The treatment of infantile syphilis must be prophylactic and curative. If the mother be suspected to be laboring under a constitutional taint, as she justly may be if she has had several consecutive abortions or miscarriages, or if she is in infirm health, with eruptions upon the skin, a plentiful discharge from the vagina, and an ulcerated condition of the neck of the uterus, she should be promptly put upon a course of mercury and a properly regulated diet, in order to prevent the ill effects of the contaminated state of her blood upon the fœtus, and thus enable the latter to attain its full growth, and the full period of gestation. The mercurial course should be chronic, not acute, and as gentle as possible, lest it should excite abortion; and in most cases it will be beneficial to associate the metal with the iodide of potassium and some preparation of iron, with a view to a tonic effect upon the general system, which, as already stated, is usually in an impaired and cachectic condition, and therefore requires great attention to bring it up to its normal level. The diet should be mild and nutritious, the clothing should be warm, and the patient should have the full benefit of fresh air.

As soon as the child is born it should be taken from its infected mother, and confided to a sound wet-nurse, as an appropriate diet is absolutely essential to its preservation. If no suitable wet-nurse can be obtained, it should have an abundant supply of fresh cow's milk, or, what is better, of the milk of the ass, which approaches nearer to the human milk, in some of its more important properties, than that of any other animal. The body and limbs should be well protected with flannel, and frequent recourse should be had to the tepid bath, impregnated with bran, or mucilage, especially if there be eruptions, fissures, or ulcers upon the skin. An abundant supply of pure air will be indispensable. The fact is, too much attention cannot be paid, in every case, to the observance of the rules of hygiene. Cod-liver oil will prove a valuable adjuvant in all cases where it agrees with the stomach.

The most important internal remedy is mercury, and it is here that this article often displays its effects to the greatest advantage in neutralizing the specific virus. If any one should doubt the efficacy of this medicine, as an antisyphilitic agent, his scepticism will soon vanish if he will take the trouble to watch the progress of the treatment and the good results that will follow it. If it is not positively a specific, it approaches as nearly this property in this disease as anything well can, quinine in intermittent fever hardly excepted. The form of exhibition is the bichloride, in doses varying from the fortieth to the fiftieth of a grain three times in the twenty-four hours, dissolved in distilled water, or, when there is need of a tonic, in a few drops of Huxham's tincture of bark. This should be steadily continued, with now and then a few days' intermission, for a number of weeks, not only until all disease is apparently gone, but for a considerable period after; and it will be well for the sake of the more complete eradication of the poison, to recur to the remedy occasionally until the child is several years of age. When the disease proves obstinate, the bichloride may generally be advantageously conjoined with the iodide of potassium, from the fourth to the eighth of a grain being given with each dose of the salt, according to the age of the child. When the body is covered with sores, pustules, or tubercles, a gentle course of mercurial fumigation will be advisable, but great care must be taken not to carry it to such an extent as to induce debility or to suffocate the child. Mild dressings may be used in the intervals, and of these the best will be very weak preparations of oxide of zinc or of the nitrate of mercury, in the form of unguent.

Cases sometimes occur where the bichloride of mercury does apparently either no good, or where it proves positively prejudicial; under such circumstances trial may be made of mercury with chalk, or, what is preferable, because not liable to cause gastro-intestinal irritation, of inunction with mercurial ointment, from half a drachm to a drachm being rubbed upon the inside of the thigh once a day, the surface being kept constantly covered with a piece of flannel. The treatment is continued for several weeks, until all evidence of the disease has disappeared.

SYPHILIZATION.

Within the last few years, attention has been directed, in various quarters, to the subject of *syphilization*, or the cure of syphilis by inoculation with the virus of chancre. As early as 1844, Dr. Turenne, in attempting to transfer syphilis from man to the monkey, was struck with the fact that, when the inoculation was repeated a number of times, the tissues to which the matter was applied were at length rendered completely insusceptible to its influence. To the condition thus obtained, he applied the term syphilization. Supposing that the treatment might be advantageous to the human system, he accordingly instituted some experiments upon men, but the results of his observations were not given to the profession until after the publication of the memoir of Dr. Sperino, of Turin, in 1851. In this memoir numerous experiments are detailed, going to show that constitutional syphilis may be successfully cured by repeated inoculation. More recently the subject has engaged the attention of other observers, especially of Dr. Boeck, of Norway, the results of whose labors have been widely disseminated through the medical press of Europe and America. I am not aware that any experiments upon syphilization have been performed in this country.

According to Dr. Boeck, syphilization is justifiable at all periods of life, but it should only be resorted to after the development of secondary symptoms; for, as long as the disease is in its primary stage, inoculation would be improper, as no one can positively determine beforehand whether the constitution will become tainted or not. The earlier the treatment is commenced, the better, and the effect will always be the more prompt and decisive, when the patient has not been subjected to any previous mercurial course, which renders the system more stubborn to its influence, and more prone to relapses.

The inoculation is performed with the virus of chancre, and it is immaterial whether the matter be taken from the indurated or the non-indurated sore. The parts selected for the operation are the trunk and the inside of the thighs and arms. In a few days pustules will form, the matter of which must be inserted into the skin, until no further effects result, when the virus of the primary sore must again be employed, and the same course be pursued as before, until it is found that no further impression can be made upon the system. It will sometimes require the use of a new virus five or six times, before complete constitutional immunity can be secured. The symptoms, as a general rule, begin to abate in from four to six weeks, but it may take a whole year before the disease is perfectly eradicated. It will be found, upon every repetition of the inoculation, that the pustules and ulcers become less and less, and, also, that they gradually lose their specific appearance and character.

In regard to the value of this treatment, it is obviously impossible, at present, to form any definitive conclusions; further observation alone can enable us to do this. The practice is, to say the least, exceedingly filthy and disgusting; a circumstance which, added to the tediousness of the cure, will probably serve as an effectual bar to its general adoption. Besides, a surgeon may, in consequence of its employment, render himself liable to prosecution and heavy fine, as in a case which recently occurred in France.

CHAPTER XII.

GENERAL DIAGNOSIS.

DIAGNOSIS is the art of distinguishing and identifying diseases and accidents, or, in other words, of determining their seat, nature, and effects. Its study is of paramount importance to every practitioner, and he should therefore omit no opportunity of improving his knowledge of it. Its value, practically considered, has been felicitously expressed by Louis, the illustrious secretary of the French Academy of Surgery. "The science of diagnosis," says he, "holds the highest rank among the different branches of the healing art, as it is at once the most useful and the most difficult. The discernment of the peculiar character of each kind of disease and of its different species constitutes the source of all curative indications. Without a clear and exact diagnosis, theory must always be at fault, and practice frequently uncertain." It is by his knowledge of diagnosis that the practitioner acquires a command over disease which he who is destitute of it can never attain. It should therefore form the great object of his inquiry in every case of disease and accident; for to be able to locate and define their seat and character is almost to be able to cure them. To be incapable of doing this is literally to grope about in the dark; or to be tossed to and fro, like a mariner without a helm, upon an ocean of uncertainty. To disentangle truth from error; to give to disease "a local habitation and a name;" to distinguish one injury from another; and to base upon the knowledge thus derived a proper course of treatment, calculated to restore the sufferer to comfort and health, are among the highest attributes of the practitioner, and require an amount of talent, tact, and experience such as few men possess.

The very first thing that a surgeon does when he is called to a case of disease is to set up an inquiry into its true nature; to ascertain where it is situated, or what structures it involves; how it has been brought about; what progress it has made; and what are its essential characteristics, or in what particulars it differs from other lesions. In order to do this with any tolerable degree of success, it is necessary, in many cases, literally to interrogate every important organ and tissue of the body, with a view of ascertaining which of them are more directly implicated in the disorder, which are free from suffering, and which are affected only sympathetically. Such a step is generally indispensable when the lesion is of spontaneous origin, or when it arises without any appreciable cause. When the converse is the case, a less elaborate examination will usually suffice to supply the requisite light. Not unfrequently the nature of the complaint is perceived at a glance.

SECT. I.—EXAMINATION OF THE PATIENT.

To examine a patient well, so as to elicit all the light that may be necessary to a thorough comprehension of the nature of his malady, requires generally great tact and an extensive knowledge of morbid and healthy anatomy, physiology, pathology, and animal chemistry, not to say anything of microscopy, now so much employed as a means of diagnosis. Any one may make a superficial investigation, and in the more ordinary cases such a mode of procedure may perhaps be all that is required; but under opposite circumstances, where everything is shrouded in obscurity, nothing short of the most patient and elaborate exploration will usually answer the purpose. Knowledge and tact alone, however, will not insure success; they may go very far, it is true, in enabling the practitioner to solve the mysteries of a case, but unless they are aided by a nice faculty of observation, and by a just sense of discrimination, he will never be able to analyze and group the facts presented to him in such a manner as to render them fully available when he comes to apply his therapeutic agents. Unfortunately, however, the power of observation is a rare gift, which few possess, and still fewer use to advantage. Surgeons, like physicians, have eyes, but they do not always see, and ears, but they do not always hear. Another fault, of which, unfortunately, too many, even among the most sagacious and best informed, are frequently guilty, is the hasty manner in which examinations are made, and, hence, no wonder that so many disgraceful and fatal blunders are daily committed by men who, if they would only give themselves proper time, might see disease as clearly as if they were looking at it in a mirror. Hasty examinations commonly lead to hasty deductions, and hasty deductions to hasty generalization and slovenly practice. All practitioners do not of course require the same amount of time to arrive at a correct judgment respecting the diagnosis of their cases; some literally jump at conclusions; others reach them only by a slow and tedious process of examination and induction. Of the two, the latter are generally the safest practitioners.

The object of an examination is often seriously interfered with, if not entirely frustrated, by the want of co-operation of the patient, in consequence of his timidity, his want of intelligence, or the perverseness of his disposition. Much adroitness is therefore often required to bring out the desired result; fully as much as the lawyer is obliged to expend in the examination of a witness who is incapable of appreciating the responsibility of his position, or of making a proper use of his knowledge. To gain the confidence of a patient is one of the first duties of a practitioner, as this is often necessary not only to a full development of the history of his case, but to its successful management. A gentle word, an agreeable tone, a winning manner, are well calculated to effect this result, and are attributes of the highest value, the more so as but few persons in our profession possess them.

Age, occupation, climate, and habits of life, being so many circumstances calculated to modify morbid action, should be among the first objects of inquiry at the bedside of the sick. There are many diseases which occur only at particular periods of life. Thus, scrofula is most common in children, scirrhus in elderly persons, chronic enlargement of the prostate in advanced age. The influence of occupation in the production of disease is well shown in hemorrhoids, varix, and ulcers of the legs, and, to go no farther, in necrosis of the lower jaw in persons engaged in the manufacture of lucifer matches. Gout, rheumatism, pneumonia, and pleurisy are most common in northern latitudes, while dysentery, hepatitis, and fever are most frequent in southern. Individuals of dissipated habits are particularly prone to erysipelas, boils, and carbuncles, and are often attacked with delirium tremens, when they become the subjects of severe injuries, as lacerated wounds, fractures, and dislocations.

Particular inquiry should be made into the previous history of the case; whether there is any hereditary predisposition to disease; whether the suffering organ was ever similarly affected before; how the present attack came on, how long it has been in progress, and what have been its chief symptoms. A careful examination of this kind cannot fail to elicit important and valuable information, which, if properly applied, may go far in saving the patient's life, or in cutting short his disease.

A knowledge of the *causes* of a disease often throws valuable light upon their diagnosis. Thus, the knowledge that a youth affected with urethritis recently had connection with a lewd female, at once leads to a proper comprehension of the nature of the case; and in the same manner important aid may be obtained in deciding between a specific and a non-specific ulcer on the head of the penis. The diagnosis of a malignant pustule upon the hand is generally determined at a glance by a surgeon of experience; but one of an opposite character will hardly arrive at such a result without being told that the patient a few days previously was engaged in flaying a cow, or in handling green hides. During the existence of endemic and epidemic diseases, all persons brought within their influence are liable to their attacks, and the similarity of the symptoms is consequently sufficient to stamp their character. The knowledge that pyemia frequently follows upon severe injuries and capital operations is of the greatest value to the practitioner, as it enables him at once to interpret correctly the symptoms which attend that peculiar affection, the nature of which was so long a mystery.

In accidents, a knowledge of the manner of their occurrence is often a matter of great moment in a diagnostic point of view. Thus, if a man, in the act of falling from a considerable height, has alighted upon the vertex, and is immediately rendered insensible, and particularly if he remains in that condition for a long time, the inference is strong that the base of the skull is fractured, and that he will perish from the effects of the lesion, although there may be no apparent injury upon the portion of the head which received the blow. In railroad accidents the leg may be severely hurt, and yet not sufficiently so to account for the extraordinary depression of the system; inquiry discloses the fact that the body was violently compressed between the car and a post, and a more thorough exploration leads to the discovery of rupture of the spleen, liver, bowel, or bladder; a circumstance which at once establishes the diagnosis, and prevents the patient from being subjected to useless amputation.

When the patient is unconscious, whether from disease or accident, valuable information respecting the nature of the affection may often be obtained from his nurses and friends; or, in the latter case, from the by-standers, who thus become important witnesses of what transpired at the moment in regard to the manner in which the injury was inflicted, the previous state of the intellect, and the condition of the person immediately consequent upon the receipt of the lesion.

In the more obscure cases of diseases and accidents, the diagnosis can be arrived at only after the most patient, thorough, and systematic examination; a random exploration will be worse than useless. Every organ must be questioned, and even then it is often extremely difficult to determine what the lesion really is. In my own examinations I usually begin with the alimentary canal, from which I pass on, successively, to the abdominal and pelvic viscera, the lungs and their envelops, the heart, brain, and spinal cord, and, finally, the external surface, carefully noting everything of importance as I proceed. In this manner, it is difficult for any serious disease to escape detection, if the practitioner is at all endowed with the faculty of correct observation.

EXAMINATION OF THE DIFFERENT ORGANS.

In general, very useful diagnostic information is afforded by the state o the *tongue* in surgical affections. In traumatic fever, abscesses, rheumatism, and gout, the organ is usually unnaturally dry, and covered with a thick, white fur, at the same time that its tip and edges are abnormally red. A narrow, pointed, or acuminated appearance of the tongue is also frequently observed under these circumstances, especially in young subjects. In profuse hemorrhages, the tongue is generally very pallid, soft, flabby, and indented at the edges. A dry, brownish, and tremulous state of this organ, with difficulty of protrusion, is generally denotive of the existence of a typhoid condition of the system, and, in connection with other symptoms of exhaustion, is to be regarded as an unfavorable occurrence. It is the kind of tongue which commonly attends gangrene, malignant erysipelas, and the latter stages of traumatic fever.

The appearances of the tongue sometimes afford useful hints respecting the state of the digestive apparatus, and even of the general system. Thus, aphthæ upon this organ, or small ulcers scattered over its surface, are usually denotive of chronic gastric disorder, or derangement of the stomach and liver, by correcting which the disease promptly vanishes. In constitutional syphilis, the existence of mucous tubercles upon the tongue affords at once a satisfactory solution of the nature of the complaint. The presence of an excavated ulcer upon this organ, or upon the tonsils, with a copper-colored border and a foul bottom, is generally equally diagnostic of a contaminated state of the system.

A thick and tumid upper *lip* is generally denotive of a scrofulous taint of the system, or of a vitiated state of the alimentary canal depending upon the presence of worms, and disorder of the hepatic and follicular secretions. A cracked, chapped, or fissured state of the lower lip is often an accompaniment of general plethora, over-feeding, and gastro-enteric derangement. A pale prolabium is indicative of a deficiency of the coloring matter of the blood, and is generally an evidence of the necessity of tonics.

Useful information is sometimes derived from an examination of the *gums*. A red, spongy, and tumid state of them is usually denotive of a scorbutic diathesis, especially if it be conjoined with frequent bleeding and hemorrhagic spots in different parts of the body. An eroded appearance of the gums is generally indicative of an accumulation of tartar, while the presence of sordes is expressive of a typhoid state of the system.

Pain in the throat and difficulty of deglutition are evidences of tonsillitis, and of disease or mechanical obstruction of the œsophagus. A careful inspection of the fauces and the introduction of the probang usually readily determine the precise locality of the affection, as well as its nature. In the former case, the tongue is carefully depressed with the handle of a spoon, or a tongue-holder, the mouth being widely opened as the patient sits upon a chair in a strong light; in the latter, the surgeon, standing behind the patient whose head rests upon his chest, carries the instrument gently and cautiously along the tube until it comes in contact with the obstruction, which is not passed all at once, or forcibly, lest undue violence should be inflicted, perhaps eventuating in rupture or ulceration of the œsophagus.

No examination in any case of disease, if at all serious, whether surgical or medical, can be considered as at all complete without a thorough exploration of the condition of the *stomach* and *bowels*. When it is recollected that disorder of the secretions of these organs, the presence of irritating ingesta, or the accumulation of fecal matter, is frequently a source of disease in other parts of the body, as well as in these organs themselves, the importance of an attentive examination of them cannot be too much insisted upon. The insertion of the finger into the rectum, and the use of the speculum, often lead to the most useful knowledge of the condition of the anus and lower bowel. An examination of the alvine evacuations not unfrequently reveals important information in regard to the state of the liver, as the presence, absence, or quality of the bile, and the action of the mucous follicles of the alimentary tube, and should never be omitted in any case of serious disease or accident.

Intellect.—The intelligence is often remarkably altered in disease and accident. Delirium and incoherency are common effects of all lesions attended with high arterial excitement. Their character, degree, and duration vary much in different cases, and are greatly influenced by surrounding and intrinsic circumstances, as the nature of our treatment, the intensity of the morbid action, the importance of the affected organ, and probably also by the idiosyncrasy of the individual. In general, as they are of a purely sympathetic character, they rapidly disappear with the excitement that induced them; coming and going perhaps several times in the twenty-four hours, especially during the vesperal and nocturnal exacerbations which are so liable to distinguish most febrile attacks, whether traumatic or idiopathic.

In organic disease of the brain and its envelops, on the contrary, a different order of things usually occurs. Here the delirium, once fairly begun, continues uninterruptedly, although it may be characterized by intervals of remission; and, as the morbid action progresses, it generally lapses into stupor, and this, ere long, into deep coma, which is but too often the immediate forerunner of dissolution. In compression of the brain, whether from extravasated blood, excessive congestion of the cerebral vessels, effusion of serum, or depression of the cranial bones, the intelligence is commonly completely abolished; the patient is deprived of all sensation and volition, and cannot be roused by the most powerful stimulants. He is, in fact, a mere automaton, dead to all surrounding impressions. If, from any cause, inflammation of the brain or of its membranes arise, the face soon becomes flushed, the eye suffused, the pupil contracted and impatient of light, the skin hot and dry, and the pulse quick, hard, and frequent. Delirium soon sets in; the mind becomes incoherent, and, although questions may still with some effort be answered rationally, yet the patient speedily lapses into his former condition, knitting his brows, tossing from side to side, withdrawing his hand from the attendant, muttering constantly, and falling gradually into a more unconscious state. Rigors generally occur early in the disease, and are always denotive of great danger. If effusion of serum, lymph, or pus take place to any considerable extent, convulsions and deep coma are sure to follow, soon terminating in death.

Countenance.—The state of the countenance is always a subject of inquiry with the intelligent practitioner. The mirror of the soul, it reflects, to a greater or less extent, alike the sensations of pleasure and of pain, of joy and of sorrow, and is thus capable of supplying important diagnostic indications in a great variety of diseases and accidents. To call attention to all the details which necessarily connect themselves with the study of the physiognomy under these circumstances, would be out of place in such a work as this, and I shall therefore content myself by referring to a few of the more frequent and conspicuous.

Excessive pallor of the countenance, especially of the prolabia, is generally denotive of great loss of blood, or of extreme shock of the nervous system. In the latter case it is often associated with a peculiar withered and shrunken expression of the features, reminding one sensibly of the decay of a leaf in autumn. In apoplectic affections of the brain, the face is turgid, flushed, and paralyzed on one side, thus causing serious distortion, the angle of the mouth being drawn to the opposite side, while the eyelid on the affected side has a drooping appearance, descending hardly half way over the ball. In general inflammatory fever, whether the result of accident or of internal causes, the countenance is red and tumid, the eye is suffused, and the ala of the nose is rapidly dilated and contracted by the hurried inspiration. When the breathing is much embarrassed, as when there is deep congestion of the lungs, or mechanical obstruction to the entrance of the air, as when a foreign body exists in the larynx or trachea, the face is livid and often remarkably puffy, particularly when the affection is of long standing, and accompanied by œdema of the subcutaneous cellular tissue. All painful affections of these organs are characterized by an anxious expression of the features, attended by an unusual dilatation of the nostrils during each act of inspiration, and by a peculiar heaving movement of the chest. "In inflammation of the abdominal viscera," observes Dr. Marshall Hall, "attended with severe pain, the muscles of the face are in a state of continued contraction; the features are unnaturally acute, the forehead is wrinkled, and the brows knit. The nostrils are acute and drawn up; the wrinkles, which pass from them obliquely downwards, are deeply marked; the upper lip is drawn upwards, and the under one frequently downwards, so as to expose the teeth. The state of the features is aggravated on any increase of the pain from change of position or external pressure. When the abdominal pain arises from spasm, the muscles of the face are exceedingly contracted and distorted during the paroxysms of pain; but in the intervals of the paroxysms the countenance assumes a calm and placid aspect."

The diagnostic value of the Hippocratic countenance has long been recognized by practitioners. Its presence is always denotive of extreme danger, and is commonly associated with other symptoms of an untoward import, as twitching of the tendons, high delirium, a dry tongue, sordes on the teeth and gums, and excessive prostration. It consists in a peculiarly sharp, retracted, and withered appearance of the features, and generally attends the closing scenes of all typhoid states of the system, whatever may be their cause or character.

Voice.—The state of the voice often furnishes useful information respecting the nature of the lesions of the larynx and trachea. Its peculiarity in croup is well known, being either sharp and shrill, like the crowing of a young cock, or low, hoarse, and almost extinct, especially if the disease has made considerable progress. In œdema of the glottis, without being always hoarse, it is generally reduced to a mere whisper; and in thickening of the vocal cords and ulceration of the mucous membrane of the larynx, partial loss of voice, and ultimately complete aphonia, generally attend.

Respiration.—The respiration should always be attentively examined. In all acute diseases, attended with unusual vascular excitement, it is increased in frequency, short, and laborious. In pneumonia and pleurisy it is generally diaphragmatic, the intercostal muscles being almost completely quiescent, with hardly any perceptible elevation and depression of the ribs. The patient, alarmed and anxious, breathes with great difficulty, dilating his nostrils at every inspiration, and raising the shoulders and upper part of the chest, so as to draw in as much air as possible at each effort. In inflammation of the abdominal viscera, on the contrary, the diaphragm is nearly stationary, while the intercostal muscles are in full play, the act of inspiration being short and panting, lest the descent of the diaphragm should produce an aggravation of suffering by rudely compressing the affected organs. In affections attended with cerebral congestion, effusion of blood, or depression of the skull, the breathing is slow, labored, and irregular; often stertorous, and accompanied by a peculiar whiff. In spasmodic diseases of the respiratory organs, the inspiration is quick and imperfect, as if the patient was unable to dilate the chest, and is usually accompanied with a characteristic wheezing sound, often audible at a considerable distance, during expiration, which is, at the same time, labored, and protracted. Short, difficult, and anxious breathing, aggravated by muscular exertion, as in ascending a hill, or rapid talking, is generally denotive of hydrothorax, and of organic disease of the heart and great arteries.

Heart.—The diagnostic signs manifested by the heart and arteries deserve careful consideration. In examining the pulse, the exponent of the great central organ of the circulation, particular attention should be paid to its frequency, volume, and force, as these constitute the leading features by which the practitioner judges of the state of the system, or, in other words, of the character and effects of the morbid action. To do this properly requires not a little knowledge and experience, for nothing varies more than the condition of the pulse in health and disease. Hence it is not surprising that it should have been pronounced by one of the older physicians to be the most fallacious of symptoms.

Pulse.—In traumatic fever the pulse, as a general rule, is quick, frequent, and hard, and similar qualities usually characterize it in idiopathic affections. The increase in the number of its beats ranges from ten to thirty and even forty in the minute; they are performed with a peculiar sharpness and rapidity, and the blood is sent into the arteries with such momentum as to cause their coats to rebound under the finger, offering thus a decided resistance to its pressure. When this is the case, the pulse is said to be hard. Hardness, quickness, and frequency are often associated with fulness, especially in very plethoric subjects, laboring under intense inflammatory excitement; but such a coincidence is by no means always necessarily present; on the contrary, instances occur where the pulse is so exceedingly small and thready as to require some care to detect it. This is generally the character of the pulse in peritonitis, from whatever cause arising, and therefore affords valuable diagnostic information. In certain affections of the brain, as in compression, whether a result of apoplexy or external injury, the pulse is slow, full, and laboring, as if the heart were oppressed by a heavy load which it found difficult to carry or to shake off. The pulse after hemorrhage is strikingly peculiar, although it is not easy to define its character; it may be described as being very sharp, quick, and thrilling, as if the blood were sent into the artery with a kind of jerk, imparting thus a vibratory sensation to the finger. Once felt, it is impossible ever to forget it. An intermittent pulse is generally denotive of organic disease of the brain, or of the heart, lungs, or great vessels; sometimes, however, it appears to be the result altogether of functional disease, as dyspepsia, or gastro-intestinal irritation.

In examining the pulse with a view to its diagnostic value, it is to be remembered that it may be naturally slow or frequent, hard or soft, full or small, strong or feeble, depending upon idiosyncrasy, or the effects of previous or existing disease.

The time and mode of examining the pulse require some attention. As a general rule, the surgeon should not put his hand upon the wrist immediately after he has sat down by the side of the bed, as such a course would be likely to cause alarm, and thus lead to erroneous inferences. Nor should he use a watch for the purpose of counting it, especially if the patient be very sick and nervous, as this also might excite injurious apprehension. In fact, it is impossible to conduct the examination too carefully; for unless this be done, the intention of the practitioner will often be completely thwarted, simply in consequence of his awkwardness. At least two fingers should be placed upon the radial artery, and the application should be continued sufficiently long to enable him to determine fully the character of its beats, particularly their frequency, volume, and power of resistance.

Kidneys.—The renal secretion should claim particular attention in every severe case of accident and disease. A very superficial inspection will generally at once detect remarkable deviations from the normal standard, both as it respects the color, quantity, and consistence of this fluid, as well as any tendency it may manifest to the formation of deposits after having stood for some time in the receiver. But if a more thorough investigation be deemed necessary, as when organic disease of the kidney is suspected, or with a view to the detection of the existence of any particular calculous diathesis, a more minute and elaborate examination, conducted with the microscope and chemical tests, will be required; and it need hardly be added that such a procedure generally calls for an amount of knowledge, skill, and experience such as few professional men possess. As this subject will receive special consideration in the chapter on the urine and its deposits, no further allusion to it need be made here.

Finally, the practitioner must not neglect to examine the state of the *skin*, noting particularly the character of its temperature, the presence or absence of moisture, the degree of its contractility, and any change of color it may have experienced; the condition of the limbs, as to the existence or non-existence of paralysis or injury; and lastly, the state of the genital organs, if, upon inquiry, there is reason to suppose that they are either the seat of the morbid action, or that they deeply sympathize in the disorder of other parts of the body.

SECT. II.—MENSURATION.

An examination of the dimensions of a part occasionally affords valuable aid in determining the diagnosis of its lesions. Such a mode of investigation is particularly serviceable in fractures and dislocations, in coxalgia, and in affections of the chest, especially in pleuritic effusions, so common after accidents and diseases.

The best contrivance for ascertaining the amount of shortening in an injured or diseased limb is the graduated tape, used by seamstresses and tailors, and inclosed in a metallic case, so as to admit of its being carried in the pocket. It is a yard in length by half an inch in width, and being composed of oil-cloth it is perfectly inextensible, thus rendering it admirably adapted to the object. In order to attain perfect accuracy of result, it is necessary that the sound and affected members should be placed as nearly as possible parallel with each other; for if there be the slightest variation in their inclination it must proportionably impair the value of the examination, if not completely destroy it. Thus, for example, in trying to ascertain the amount of overlapping of the fragments of a broken femur, the two thighs should not only be placed parallel with each other, but great care should be taken that they, as well as the buttocks, rest evenly upon the bed, table, or floor on which the patient lies. Finally, in order to perform the operation in the most unexceptionable manner, the additional precaution should be taken of maintaining the head, chest, pelvis, and extremities all in a straight line until the measurement is completed.

After the limbs and body have been adjusted as here described, two fixed points are selected, between which the tape is stretched. Thus, to take the thigh again as an illustration, the two proper points are the anterior superior spinous process of the ilium and the inner border of the patella. The distance between these two prominences having been ascertained upon the affected member, the tape is next stretched between the same points on the sound limb, the difference in the length between the two being the sum of the shortening of the injured bone. Where no fixed points can be obtained, a mark may be made upon the skin either with ink, or nitrate of silver.

The graduated tape may also be employed for measuring the diameter of a limb, as in disease of an important joint, or a suspected morbid growth. Or, instead of this, recourse may be had to the graduated compass of Mayor, which, however, notwithstanding its ingenious mechanism, really possesses no real advantages over the tape. This instrument consists of four pieces, the central one, which is a flat rod, being marked by a scale of inches and lines.

Mensuration of the chest is often practised in pleuritic effusions, although such a means of diagnosis is seldom necessary in the hands of an intelligent and skilful surgeon, auscultation, percussion, and inspection being quite sufficient for the purpose in almost every instance coming under his observation. When more than ordinary care is desired, the graduated tape, extending from the middle of the sternum to the centre of the spine, will readily supply the requisite information.

The plumb-line is occasionally used for determining the existence of curvature of the spine; such an expedient, however, can only be necessary in the earlier stages of the malady, before marked deformity has set in. When the disease is fully established, such a mode of investigation would savor alike of affectation and stupidity.

A ready method of determining the angle of an object, as, for example, that of a broken bone, has been suggested by Malgaigne. It consists in applying a sheet of paper, by its edge, to the limb so as to represent its vertical axis. At the point where the axis changes its direction, the paper is so folded as to follow it exactly; the result will be that the salient angle thus formed will necessarily give the entering one caused by the fragments of the deformed bone. In order to determine the degree of this angle, a sheet of paper is folded in four, which "makes a right angle, or 90°; folding again one of the sides affords an angle of 45°; adding this angle of 45° to the unchanged right angle, gives an angle of 135°, and so on. Applying now this extemporaneous quadrant to the already ascertained angle of the fracture, we obtain, without trouble, or loss of time, as accurate an estimate as possible."

SECT. III.—ATTITUDE OF THE PATIENT.

The attitude of the patient and the position of the affected part are variously and often remarkably changed in diseases and accidents, and afford, in many cases, valuable diagnostic indications, not attainable in any other way. The study of the variations in the configuration of the body is of much greater moment, as a means of distinguishing different lesions, than is generally imagined, and has received less attention than its importance merits. In some affections, the diagnosis absolutely hinges mainly, if not entirely, upon the attitude assumed by the patient in consequence of the morbid action. We need only instance the peculiar distortion of the body in tetanus, caused by the continued and violent contraction of the muscles, drawing the trunk, in one case, powerfully forwards, in another backwards, and in a third to one side. No one that has ever witnessed this change of configuration can possibly mistake it in a similar attack; for there is no other lesion capable of producing it. In caries of the vertebræ, usually known as Pott's disease, and in lateral curvature of the spine, the result of irregular muscular action, the distortion of the body is characteristic. In coxalgia, the flattening of the hip, the elevation of the pelvis of the affected side, the retraction of the heel, and the effacement of the femoro-gluteal fold are among the most valuable diagnostic signs of the malady.

In diseases and injuries of the chest, the position of the patient is often highly characteristic. In inflammation of the lungs and pleura, attended with slight effusion, he generally lies either on the affected side, or else upon his back, not on the sound side, as the weight and pressure of the diseased organ would seriously impede respiration and excite violent coughing. In hydrothorax, with large accumulations on both sides, the patient is obliged to raise his head and shoulders very much, or even to sit up in bed, in order to obtain the requisite supply of air. When he lies down, the effused fluid is diffused over a larger portion of lung, an occurrence which is instantly followed by increased difficulty of breathing, and by the necessity of a change of posture to prevent impending suffocation. "When out of bed, he is often observed to sit with the arms placed along the side, and the hands fixed and pressing forcibly on the chair or sofa on which he rests; in other cases he leans a little backwards, still supported by the arms and hands, which are pressed behind his back."

The attitude assumed by the patient in inflammation of the abdominal and pelvic viscera is generally very striking and characteristic. Unable to shift his position, he lies constantly upon his back, with his head and shoulders considerably elevated, the knees raised, and the thighs partially flexed, the object being to relax the abdominal muscles in the greatest possible degree, so as to take off their weight and pressure from the inflamed surface. In spasmodic affections, on the contrary, the position of the patient is altogether different; instead of observing dorsal decubitus, he lies at one time on this side, and then on the other, now on the back, and next on the belly; and instead of avoiding pressure he actually courts it, not feeling comfortable without it. Hence, he often doubles himself up, and twists and contorts his body in almost every possible manner, in order to obtain relief.

In stone of the bladder impeding the flow of urine, the attitude of the patient is frequently very singular. Sometimes he is compelled to assume a stooping posture; at other times he crosses or separates his legs, inclines his body to one side, lies down, rests on his elbows and knees, or lies on his back, and throws up his buttocks. In traumatic and other affections, attended with typhomania, retention of urine may be suspected, if the patient lies on his back with the limbs retracted. In acute inflammation of the kidney, the body is generally inclined a little forwards and towards the affected side, so as to relax the lumbar muscles, and take off any pressure they might otherwise exert upon the diseased organ.

The nature of an accident is not unfrequently revealed by the attitude of the part and body; sometimes by the one, sometimes by the other, and occasionally by both. Thus, the manner in which the patient inclines his head and supports his arm in fracture of the clavicle is so peculiar as to be absolutely, in great degree, pathognomonic of the nature of the lesion. Dislocations of the shoulder, hip, and other joints, are denoted by striking, if not characteristic, changes in the attitude of the body and limb. The existence of a fracture is often revealed by a peculiar change in the conformation of the affected member, consisting either in a marked shortening, or in a peculiar alteration in the axis of the part. The disease called wry-neck derives its name from the peculiar twist of the neck by which it is distinguished.

SECT. IV.—EXTERNAL CHARACTERS.

Important diagnostic data are sometimes furnished by the color, form, consistence, mobility, pulsation, temperature, crepitation, sensibility, or odor of a part, and by the spots, scars, or ulcers existing upon its surface. A mere glance at these different topics will serve to show their value as means of distinguishing morbid action, whether it be considered simply in reference to its nature, or its nature and degree.

Thus, as stated under the head of inflammation, the *color* of the diseased part may be scarlet, as in inflammation of the mucous membrane of the fauces; lilac, as in sclerotitis; grayish, or brick-colored, as in iritis. When the redness occurs in the form of a streak, extending up the arm or leg, it is denotive of phlebitis, or of angeioleucitis. Diffuse discoloration characterizes erysipelas; circumscribed discoloration, boils and carbuncles. A scarlet hue implies great vascular activity, such as exists in acute inflammation; a purple hue, on the contrary, denotes partial stasis of the blood, which, if not soon arrested, may lead to gangrene.

Change in the *form* of a part may be caused by swelling, as in inflammation attended with effusion, or it may depend upon the presence of a new growth, or it may be the result simply of hypertrophy. In fractures it is caused by displacement of the ends of the fragments; in dislocations by the presence of the head of the bone in its new situation. In hernia, very striking changes generally attend the figure of the affected parts, especially when the protrusion is old and unusually bulky.

Extraordinary *consistence* of a part is indicative either of excessive induration from inflammatory deposits, particularly semi-organized lymph, or of the presence of a solid tumor, or a displaced bone. When the part is unusually soft, the alteration of consistence may depend upon the presence of pus, fluid blood, serum, or serum and lymph, and often requires the closest scrutiny for the successful detection of its precise character. Under such circumstances the history of the case frequently affords important diagnostic data, especially the age of the accumulation, and the presence or absence of inflammatory symptoms. If the part fluctuates distinctly, and is, withal, red, tender, or painful, the probability is that the alteration of consistence is due to the existence of pus; if, on the other hand, it be perfectly free from discoloration and uneasiness, although the undulation under pressure may be most perfect, the conclusion must be that the disease is either a chronic abscess, or else some serous or hematoid cyst.

The *mobility* of a part may be diminished or increased, thus throwing important light upon the nature of the case. As a general rule, it may be stated that it is lessened in dislocations, and augmented in fractures. The value of this symptom is well shown in diseases of the articulations, as well as in inflammation of other parts of the body, which, if at all seriously involved, have their mobility always proportionably diminished. In malignant tumors, loss of mobility of the morbid growth generally forms a prominent phenomenon in the advanced stage of the disease, in consequence of the firm adhesions that take place between it and the surrounding structures. A similar effect may be produced by the manner in which such tumors are bound down by the aponeuroses and muscles. In affections of the eye an alteration of the mobility of the iris often affords most important diagnostic information.

Abnormal *pulsation* in a part leads to the suspicion of the existence of aneurism, and this suspicion will almost be converted into certainty, if, in addition to this phenomenon, there is a peculiar thrill, with a vibratory sensation, and a decided diminution of the volume of the part upon the application of pressure to the cardiac side of the artery supplying it with blood. The mere fact of the existence of abnormal pulsation should put the surgeon upon his guard, in order that, by redoubling his efforts at a thorough exploration, he may not commit any errors of diagnosis; laying open, perhaps, an aneurism, when he supposes that he is dealing only with an abscess or a hygroma.

The surgeon occasionally meets with what is denominated *crepitation*, a rough, grating, or friction sound, of great value as a diagnostic in fractures, emphysema, and inflammation of the sheaths of the tendons. In many cases it may be both felt and heard. In fractures it is produced by rubbing together the ends of the broken bone, and is generally so distinct as to be completely characteristic of the nature of the lesion. In order to elicit it, a good deal of management is often necessary; but in general it will be sufficient, after the ends of the broken bone have been fairly placed in contact, to grasp one piece firmly, and to hold it so while the other is rotated on its axis; or both fragments may be moved simultaneously in opposite directions.

The crepitation of emphysema is a kind of crackling sound, similar to what is produced by the rumpling of dry parchment, or by rubbing together numerous little dry, friable balls filled with air. The part, moreover, feels soft and puffy, and the contained air may be easily pressed from one spot to another.

Bony tumors of the antrum of Highmore and of the lower jaw, attended with great expansion and attenuation of their walls, occasionally emit, when pressed between the fingers, a peculiar crackling noise, similar to that of dry parchment. The sound thus elicited, however, is altogether different from crepitation, properly so termed, and its chief value consists in showing the alteration which the osseous tissue is capable of undergoing when it is subjected to long-continued eccentric pressure.

The crepitation attendant upon inflammation of the sheaths of the tendons is altogether different from the two preceding varieties, resembling the sound caused by rubbing dry starch between the fingers. When the disease is chronic it may sometimes be both heard and felt. It evidently depends upon the presence of plastic matter, and is most common about the wrist and ankle. This sound is often closely imitated in affections of the mucous bursæ, especially when they are pretty well distended with fluid, intermixed with flakes of lymph and fibrinous concretions.

A faint crepitating sound is sometimes produced by breaking up the clots of a sanguineous cyst, and rubbing the fragments between the fingers. The noise, when it does occur, is always most distinct at the base of the tumor, where most of the solid matter is necessarily collected.

An alteration of *temperature* in parts affected with disease is sufficiently common, and occasionally affords valuable diagnostic intimations. With what interest does not the surgeon watch the rise of heat in a limb after the ligation of its principal artery! A casual examination is generally sufficient for its detection; when more than ordinary nicety is required, recourse may be had to the thermometer. The intensity of the morbid action may sometimes be pretty accurately measured by merely observing the increase of its temperature. A sudden diminution of temperature, in a part previously in a high state of inflammation, may generally be regarded as an omen of unfavorable import, as it is denotive of the approach of gangrene.

An increase of the *sensibility* of a part is a frequent, if not an almost constant, occurrence in disease, especially when it is of an acute character. In ophthalmia, the slightest ray of light is a source of distress to the patient; in otitis, the ear is intolerant of sound; and in gastritis the stomach is oppressed by the smallest quantity of fluid, however bland, or however cautiously used. Parts, such as bones and ligaments, that are perfectly devoid of feeling in health, often become exquisitely sensitive in inflammation; and thus it is that the practitioner is not unfrequently enabled to detect the existence of morbid action in structures hidden from view, much better than he can in any other manner. The proper way of ascertaining the existence and amount of morbid sensibility is to make gentle and methodical compression, or to percuss the affected part, so as to communicate to it the vibrations of the whole hand, or, what is preferable, of one of the fingers.

When pain exists, a careful distinction should be drawn between that which arises from inflammation and that produced by spasm and neuralgia. In inflammation, the pain is steady and persistent, increased by motion and pressure, commencing with the morbid action, keeping regular pace with it, and gradually disappearing as the morbid action declines. In spasmodic affections, or colic, on the contrary, the pain is paroxysmal, or marked by distinct intermissions; abrupt, both in its invasion and departure; relieved by pressure, and change of posture, and generally attended with flatulence of the stomach and bowels. In neuralgia, the pain occurs in transient and violent paroxysms, darts along the course of the affected nerves with the rapidity of lightning, and is usually accompanied by more or less tenderness of the part, without any distinct tumefaction, discoloration, or augmentation of temperature.

Finally, there are certain affections which may sometimes be readily diagnosticated by a careful examination of the *cutaneous* surface, and that of the mucous outlets. Thus, if there are copper-colored eruptions upon the skin, and excavated ulcers on the fauces, or tubercles upon the tongue, cheek, or lip, no one could fail to conclude that the system was laboring under a syphilitic taint. Partial or complete destruction of the uvula, tonsils, or arches of the palate, would inevitably lead to a similar inference, especially if, added to this, there is evidence of actual disease. Scars upon the cutaneous surface, scattered irregularly about, large, deep, white, and permanent, are generally denotive of the former existence of rupia.

The character of an ulcer will sometimes lead to the detection of its cause, or to the state of the system which has induced its development. Last autumn a girl, aged fourteen, was brought to my Clinic at the Jefferson Medical College, on account of a large chronic ulcer seated in front of the leg, directly over the tibia; it had been in progress for the better part of a year, was excessively painful, and had resisted a great variety of local and constitutional remedies. Having brought the patient under the influence of chloroform, I scraped away a thick mass of semi-organized substance which formed the bottom of the ulcer, together with the carious and softened portion of the bone; and when she returned to me a week afterwards I was struck with the remarkable improvement that had taken place both in the part and system. Shortly after her visit, however, not less than five or six small unhealthy-looking ulcers, with thick, everted edges, and a foul, nasty surface, broke out around the old one, which by this time had also changed for the worse. Convinced that the disease was of a syphilitic nature, I placed the patient, without any further inquiry into the case, upon the use of iodide of potassium and bichloride of mercury, under the influence of which, and a nourishing diet, she rapidly regained her health and strength, with good sound cicatrices.

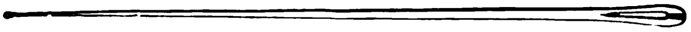
Thus it will be perceived that the diagnosis in this case, founded upon the appearance and obstinacy of the patient's ulcers, was confirmed by the result of the treatment employed for their cure.

SECT. V.—INSTRUMENTAL EXPLORATIONS.

There are certain affections whose character can be ascertained only by a careful examination with the aid of instruments, full access to them in any other manner being impracticable. The instruments mainly required for this purpose are the probe, bougie, sound, speculum, stethoscope, and exploring needle, each of which will therefore demand some notice.

Probe.—The probe, fig. 94, is chiefly employed for the purpose of exploring fistulous tracks and sinuses, the course of balls, and the presence of foreign bodies. It may therefore be considered as a highly valuable instrument, one which is daily and hourly brought into requisition by the surgeon in extensive practice. It is generally made so as to be flexible, being composed of silver, or other suitable metal; and varies in length, diameter, and shape according to circumstances. The ordinary pocket probe is about five inches in length, and of the diameter of a crow-quill, one extremity being blunt, the other somewhat pointed, or furnished with an eye. For exploring the lachrymal passages a much more delicate instrument is required; the uterine probe, on the contrary, is very large; a long and rather stout instrument is generally

Fig. 94.



employed for ascertaining the existence of a foreign body in the air-passages after having opened the trachea, for tracing the course of a ball, and for exploring certain varieties of fistules and sinuses.

The *index finger*, when sufficiently long, and not too thick, is the best probe of all, as the information furnished by it is generally much more reliable than that supplied by a metallic instrument. It is particularly avaliable in the examination of the vagina, uterus, and rectum, whether the object be to detect the presence of disease, malposition, or the existence of an extraneous body.

The *rectal touch*, performed with the index finger, is constantly practised by the surgeon in sounding patients for stone in the bladder, with a view not only of ascertaining the presence of the foreign substance, but also for the purpose of determining its size and situation. Enlargement of the prostate gland, and the existence of calculi in its substance, can seldom be satisfactorily diagnosticated in any other manner. Displacements of the uterus, pelvic tumors, and malformations of the internal genital organs, are often promptly detected by the rectal touch; and there is no practitioner that does not employ the finger in suspected disease of the anus and lower bowel. The rectal touch can readily discriminate between a hemorrhoidal tumor and a carcinomatous growth, a polyp, a prolapsus of the mucous membrane, or a foreign body. The extent of the spasmodic contraction of the anus, which attends fissure of that outlet, is generally readily ascertained by the insertion of the finger.

The *vaginal touch* affords important information in relation to the diseases of the vagina and uterus. It is in this manner that the practitioner ascertains the existence of the various kinds of tumors that are liable to form in these organs, whether benign or malignant, and also the different displacements to which they are subject. A practised finger will readily detect a carcinomatous ulcer of the uterus, a rent in the vagina, and a calculus in the bladder.

Whatever instrument is employed, it should be well oiled and warmed, to facilitate its introduction, and great care should be taken to pass it along in as gentle and easy a manner as possible. If the parts requiring to be explored are inflamed and tender, it may be necessary, before undertaking the examination, to lessen the sensibility by preliminary treatment, consisting of soothing measures, otherwise it may be productive of severe pain and an aggravation of the disease. No general rules can be laid down respecting the position of the part or of the body during the examination, although it must be sufficiently obvious that this is a matter of paramount importance to a satisfactory result. In exploring fistulous tracks it is occasionally necessary to enlarge their orifice somewhat, in order to afford a more ready passage to the instrument or finger.

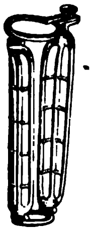
Bougie.—For ascertaining the condition of the mucous outlets of the body, as the urethra, œsophagus, and rectum, a bougie, which is but another name for a probe, is generally employed, the principle upon which the examination is conducted being the same as in exploring a part with the probe properly so called; that is, the instrument, which is either straight or curved, and composed of gum elastic or metal, is well oiled and warmed, and then carefully introduced as far as the seat of the obstruction, the distance between which and the external orifice is now determined by looking at the graduated scale upon the surface of the bougie, or by making a scratch upon it with the nail. The examination is completed by insinuating the instrument gently into the stricture, so as to measure its extent, and the degree of its resistance. The information thus elicited is generally of the greatest diagnostic and practical value.

Sound.—The instrument employed for exploring the bladder is called a sound, although it is in reality nothing but a probe, blunt pointed at the distal extremity, and a good deal curved, so as to adapt it to the course and shape of the urethra. It is composed of steel, being perfectly smooth, and of a round shape. Its object and mode of use will claim special attention in connection with the diagnosis of vesical diseases, which could not be established satisfactorily in any other way.

Speculum.—Of the value of the speculum as a means of diagnosis in affections of the vagina, uterus, anus, nose, and ear, it is unnecessary to say anything of a formal character, as it is fully appreciated by every sensible practitioner. Indeed, it is only surprising when we consider the great aid which we derive from its use that its employment should still be so much restricted, as it seems to be, in certain parts of this and other countries. Invented at an early period of the science, it was completely lost sight of for many ages, until it was re-introduced, about thirty years ago, to the notice of the profession by Recamier, who thus conferred an inestimable benefit upon the public.

The speculum is composed of polished metal, or of glass, and consists either of a cylinder, or of two, three, or four movable blades, secured by screws, and furnished with an appropriate handle. A wire speculum (fig. 95) is sometimes used. For most purposes to which such an instrument is applicable the cylinder answers exceedingly well, and it possesses the additional recommendation of simplicity of construction, convenience, and cheapness. The valvular speculum, on the contrary, is a complicated contrivance, expensive, and liable to get out of order. Nevertheless, there are certain forms of disease, especially of the uterus, which hardly admit of satisfactory exploration by any other means. Whatever form of instrument be selected, it should be well oiled and warmed, and then carefully inserted into the cavity which it is designed to explore, the patient having been previously placed in the most eligible position for undergoing the examination. Unless the case is one of unusual urgency, the examination should always be put off until there is a clear day, as the light of the sun is far better, as well as more convenient, than an artificial one. In exploring the uterus, the touch should precede the introduction of the speculum, with a view of ascertaining the existence or non-existence of any displacement of that organ.

Fig. 95.



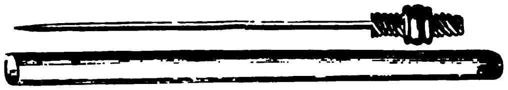
I have never found it necessary to use an oral speculum, an instrument occasionally met with at the cutler's shop. Making the patient take a full inspiration, while he holds his mouth wide open, will generally permit a thorough inspection of the tongue, cheeks, and fauces; where greater nicety is required the tongue may be depressed with the handle of a spoon, a spatula, or a tongue-holder, and the tonsils and arches of the palate separated by means of a director or a long probe.

Exploring needle.—The value of the exploring needle cannot be too highly appreciated by the practical surgeon, as he is obliged to use it in the examination of a great variety of external affections, the diagnosis of which does not admit of accurate determination in any other manner. On the other hand, however, there is reason to believe that there is no instrument, certainly none of its size, that is more frequently misapplied by the uninformed practitioner, or one which may do a greater amount of harm when used without proper judgment and discrimination. Like everything else that is good, it is liable to abuse; a circumstance which cannot be too strongly impressed upon the mind of the young surgeon. I am sure I have seen immense injury and even loss of life produced by its careless and reckless use.

Numerous exploring instruments are in the hands of the profession; some of which, displaying great delicacy and ingenuity, seem to combine all the advantages that such contrivances are capable of affording, while others are extremely clumsy, and, consequently, very imperfectly adapted for the purpose they are designed to fulfil. The great fault with most of them is that they are too large, thus inflicting an amount of injury upon the affected part, which, especially in malignant diseases, is often followed by the most disastrous effects, causing, perhaps, not merely severe pain and hemorrhage, but such a change in the vital relations of the morbid growth as to lead to its rapid development, if not to the speedy destruction of the patient. I recollect seeing, some years ago, a tumor upon the hip of a lad, aged sixteen, which, after having been subjected to various examinations by highly respectable surgeons, was at length pierced with a large exploring needle. The swelling, which had been supposed to be nothing but a chronic abscess, and which for some time had been almost stationary, now rapidly increased in volume, ulcerated, and fungated, and in less than a fortnight destroyed life. Dissection showed that the morbid growth was one of the encephaloid kind, the activity of which had been greatly augmented by the changes induced in its vital relations by the injury done by the instrument. A large volume might be filled, if one had time, with a rehearsal of the mischief that has been committed by the exploring needle in the hands of careless and unscrupulous practitioners.

Exploring needles consist either of a solid cylinder or of a species of trocar and canula, sharp-pointed, fine, and perfectly smooth, so as to facilitate their introduction and easy management. They are made of various lengths and diameters, according to the depth, volume, and nature of the part to be examined. The annexed cut, fig. 96, represents an exploring needle, with a lateral groove. The best instrument of the kind, according to my experience—one which answers every purpose in superficial affections, and which may always be used with the most perfect safety—is the ordinary cataract needle, spear-shaped, and sufficiently stout to prevent it from breaking. This is inserted into the most prominent portion of the tumor or morbid accumulation, with a sort of rotatory motion, the object being to condense, as it were, the edges of the opening to promote the escape of the contents of the swelling, which readily occurs, if they are of a fluid consistence, a drop of the liquid often adhering to the instrument, or resting upon the orifice of the little puncture. When the contents are of a semi-solid nature, or the tumor is very deep-seated, the needle should be larger, or, what is preferable, it should be replaced by a very small trocar, long enough to reach and penetrate the affected structures. Whatever instrument be used, it must not, on any account, be permitted to come in contact with any important vessels or nerves. When the swelling is of unusual bulk, it may be explored at several points of its extent at the same sitting. The little puncture made in the operation should be immediately closed with adhesive plaster or collodion. When the object is to exclude the entrance of air, the instrument may be

Fig. 96.



carried some distance between the integument and the swelling, so as to make the opening somewhat valve-like.

A needle, perforated in its entire length, has lately been recommended, on the ground of its superior efficacy in exploring deeply-seated disease, its great value consisting in the facility of discriminating between different kinds of fluids, or in reaching deeply-seated fluids without the admixture of the superficial.

Dr. Addinell Hewson, of this city, has invented an exploring instrument for the purpose of obtaining a small portion of a tumor, or morbid deposit, with a view to a microscopical examination of its structure, the tube which he employs for this object being furnished with a peculiar contrivance attached to the rod which slides in its interior. Such a procedure, it strikes me, is more ingenious than useful, as its disturbing influence upon the morbid mass can hardly fail, at least occasionally, to impart new life and energy to the affected tissues.

Ophthalmoscope.—Another instrument has lately been added to our diagnostic armamentarium; this is the ophthalmoscope, of which due mention will be made in the proper place. Whether the high expectations anticipated from its use will be fully realized time alone can determine.

Laryngoscope.—This is an instrument of very recent introduction into medical and surgical practice. It is intended, as the name implies, to assist in exploring the larynx, and the only objection to its employment is the difficulty of its application, few practitioners being possessed of the requisite degree of tact to use it to advantage.

Otoscope.—To Mr. Toynbee, of London, belongs the merit of introducing an instrument called the otoscope, which promises to be of great aid in the examination of the ear, with a view of determining its precise condition in cases of supposed disease. It is of very simple construction, as well as of easy application, and is likely to come into extensive use.

Stethoscope.—The use of the stethoscope, as a means of surgical diagnosis, is comparatively limited, and it might be altogether dispensed with by those who have a well practised ear, and are not averse to the employment of immediate auscultation, or the direct application of the ear to the affected parts. Lisfranc thought that the stethoscope might be advantageously resorted to for the purpose of detecting crepitus in deep-seated fractures; or, what is the same thing, in fractures covered by a large amount of muscular and other tissues, as, for example, in those of the neck of the thigh-bone in very fleshy subjects. Few occasions, however, can arise in which such a mode of exploration can be of any real service, and I am not aware that any of our more experienced practitioners ever employ the instrument with this object.

Laennec, long ago, proposed auscultation as a means of detecting the presence of calculi in the bladder. He thought that it would be particularly serviceable in ascertaining the existence of very small concretions, which, when struck with the sound, emit only a very indistinct noise; and he suggested that, under these circumstances, the stethoscope should be applied to the pubic or sacral region while the instrument was being freely moved about in the organ. The recommendation, however, has not met with any particular favor, and there are, I suppose, few surgeons who would feel inclined to cut a patient for stone on such slender evidence of its presence.

The chief value of auscultation, then, is restricted to the examination of diseases of the heart, pericardium, lung, and pleura; and to the investigation of certain lesions of the abdomen, uterus, and ovaries, simulating pregnancy, with a view to the detection of the fœtal circulation. Dry tapping, as it has been emphatically called, would probably be of much less frequent occurrence, if the stethoscope were oftener employed in supposed dropsy in young unmarried females.

SECT. VI.—EXAMINATION OF THE DISCHARGES.

The discharges, normal and abnormal, from different parts of the body, often furnish the surgeon important diagnostic information. Thus, an habitual flow of tears over the cheek is usually denotive of disease of the lachrymal passages, and necessarily suggests the propriety of a careful examination of them with a view to the detection of obstruction. For a similar reason the surgeon is prompted to inspect the ear in otorrhœa, and the nose when it is the seat of muco-purulent profluvium. The very nature of the discharge informs him of the existence of inflammation, but how that inflammation is produced, whether by the presence of a foreign body, a piece of dead bone, or a polyp, is a question which can only be decided by the most careful scrutiny; requiring, perhaps, the employment of the syringe to wash away the secretion, and repeated inspection before the precise nature of the case can be satisfactorily made out. One of the most important symptoms of inflammation of the maxillary sinus is a flow of pus into the throat; but no surgeon can be certain that it proceeds from that cavity unless he has previously ascertained that there is no disease of the mucous membrane of the nose.

The character of the *sputa* has long been an object of study with practitioners on account of the useful information which they afford in regard to the existence of particular diseases. Such information is hardly of less value to the surgeon than to the physician, as it apprises him of the presence of lesions which forbid surgical interference, or place him in possession of useful data respecting the occurrence of pulmonary complications, so common after accidents and capital operations. The reddish streaks in the expectoration excite suspicion of the existence of pneumonia; the rust-colored sputa confirm that suspicion, and at once invest the case with its proper importance. The fetid putrilaginous matter coughed up in gangrene of the lungs is characteristic of that disease from whatever cause proceeding. In phthisis, after the occurrence of caverns, the expectorated matter is ejected in distinct rounded masses, with irregular and indented edges; it sinks in water, and is of a yellowish color, with various shades of ash and even green, and streaked with opaque specks. A discharge of blood by vomiting is denotive of hemoptysis when the fluid is of a scarlet color, and of hematemesis, when it is perfectly black. In affections of the throat, attended with thick mucous or muco-purulent secretion, the sputa are sometimes streaked with blood. The saliva in mercurial stomatitis has a characteristic odor, and the same is true of the discharge which accompanies gangrænopsis.

A thick yellowish discharge, more or less abundant, from the *vagina*, is indicative of inflammation of that canal, of the uterus, or of both, and the addition of blood may usually be regarded as an evidence of concomitant ulceration. In the virtuous woman such a profluvium is generally to be considered as the result of accidental causes; in the courtesan, on the contrary, it at once awakens a suspicion of the existence of gonorrhœa or chancre. In cancer of the womb, the disease is attended, in its earlier stages, by hemorrhage, and afterwards, when ulceration has set in, by a foul, purulent, or sero-sanguinolent discharge, more or less copious, and so excessively fetid as to indicate unmistakably the character of the lesion.

In the male, a discharge of matter from the *urethra* generally furnishes useful information respecting the character of the disease under which the individual is laboring. When the discharge is thick, yellowish, and abundant, it is denotive of gonorrhœa, or chancre, though in the latter case it is seldom very profuse; when thin, and lactescent, or like the white of an egg, it indicates the existence of gleet, or prostatorrhœa. A large and sudden discharge, especially when no profluvium precedes or follows it, is to be taken as an evidence of spermatorrhœa.

The presence of *spermatozoa* in hydrocele sometimes throws important light upon the source of the water. It has been ascertained that whenever the fluid contains animalcules of this kind, the disease is generally of an encysted nature; for, although they also occur in ordinary hydrocele, yet the circumstance is so uncommon that it must be regarded as altogether of an exceptional character.

Of the signs afforded by the *renal* and *urinary secretions*, as evidences of disease, either of a local or general character, proper mention will be made in the chapter on the affections of the urinary organs. Here I shall only add that a careful examination of these secretions is often a matter of paramount moment to the surgeon, especially when he is obliged to decide respecting the propriety of a severe operation, the result of which might be seriously compromised by the existence of organic lesion either of the kidneys, or of some other important viscera. Hardly any man, however reckless, would enter upon such an enterprise if the urine were loaded with albumen.

The existence of disease of the *anus* and rectum, and even the true nature of such disease, may often be satisfactorily inferred by the discharges furnished by these parts. A flow of pure blood, especially during defecation, is generally denotive of internal hemorrhoids; so also if there be frequent evacuations of thick, bloody mucus, either while the person is at the water-closet, or in the intervals of his visits. A narrow, compressed, or flattened state of the feces is indicative of mechanical obstruction, occasioned either by stricture of the rectum, enlargement of the prostate gland, or contraction of the anus. In ulcerated cancer of the lower bowel, the discharges are generally very profuse, of a muco-purulent nature, mixed with blood and mucus, and excessively fetid; in fact, characteristic of the nature of that horrible malady.

The matter of certain *abscesses* serves to point out their nature and situation, or their accidental communication with neighboring parts. Thus, in the mammary gland, the fluid may contain milk; in the liver, bile; in the kidney, as when an opening takes place externally, urine. Abscesses of the wall of the abdomen have been known to contain biliary calculi; of the joints, fragments of cartilage and bone. In acute abscesses, the contents are thick and yellowish; in chronic, or strumous, thin and slightly greenish, with an intermixture of small, opaque, whitish flakes, resembling grains of boiled rice.

The discharges accompanying *ulcers* generally afford valuable hints respecting the kind of action that is going on in them. Healthy granulating ulcers or wounds always yield a thick yellowish pus, possessing all the properties of laudable pus, as described under the head of Suppuration; when, on the contrary, their action is unhealthy, the discharge is thin and bloody, ichorous, or sanguinolent, and more or less irritating. In cancerous ulcers, the discharge is generally profuse, foul, devoid of pus globules, and excessively fetid. In ulcers of the bones, it is ichorous and irritating; never healthy, so long as there is any diseased osseous tissue.

The *odor* emitted by a part in a state of disease sometimes supplies important data for the diagnosis of a case. Most readers are familiar with the remarkable anecdote related of J. L. Petit. Travelling through Germany, this celebrated surgeon, while stopping at an inn to change horses, was struck with the odor of gangrene, which he distinguished from several others, hardly less offensive. Not understanding the language of the country, he made his wishes known to a female who showed him into an adjoining room, where he found a man apparently moribund from a mortified intestinal hernia. Happy in being able to render him some assistance, he carefully dressed the parts, and meeting, before he set out upon his journey, with a French physician, he instructed him in the future management of the case. Upon his return, five months afterwards, he had the gratification to learn that the man had completely recovered his health without a stercoraceous fistule.

The odor attendant upon ozæna is characteristic; no one that has ever perceived it can mistake it. The contents of an abscess at the verge of the anus always emit a fecal smell; a peculiar fetor accompanies the formation of a urinary fistule, and no one can be deceived by the odor of the breath in salivation. In hospital gangrene the stench is so remarkable that, once noticed, it can never be forgotton, although it is so unlike everything else of the kind as to render it impossible to define or describe it. The odor which accompanies gangrene of the mouth of children is unmistakable. The diagnosis of ulcerated cancer of the uterus can often be established by the sense of smell alone. Large wounds in a state of profuse suppuration not unfrequently exhale a peculiar nauseous or sickening odor, in some degree characteristic of the action attending them. The pus of scrofulous lymphatic ganglion, for a long time pent-up, is sometimes horribly fetid. A smell, similar to that of a macerating tub, often attends abscesses depending upon caries of the spine. In all these cases, as well as in many others that might be adduced in illustration of the subject, it is probable that the peculiarity of the odor is due partly to the admixture of the natural secretions of the structures affected.

SECT. VII.—MICROSCOPICAL EXAMINATION.

The study of surgical affections has been much advanced of late years by the use of the microscope, the improvements in which during the last quarter of a century have been so important as to have actually established a new branch of science. Discoveries and investigations made by means of this instrument must be alluded to in connection with nearly every form of disease, and its aid will often be found essential to the complete study of particular cases occurring in practice. A concise description of the different varieties of microscopes, and their employment, will therefore not be out of place here.

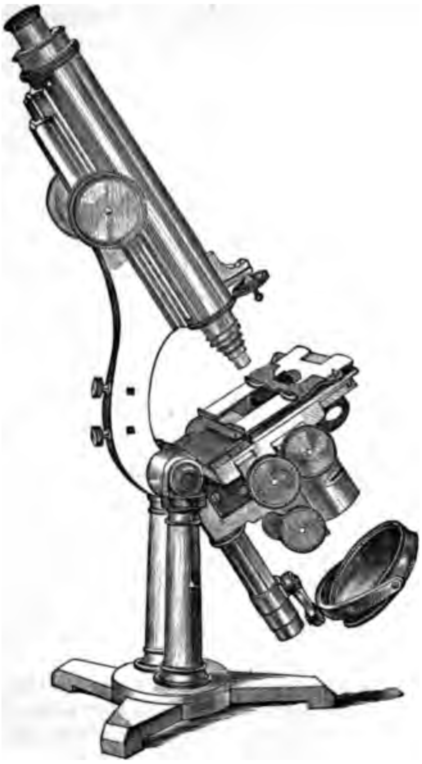
The fundamental principle of all appliances for assisting vision is to be found in the refractive power of certain media upon rays of light. Glasses, generally of a lenticular shape, single or combined, are the media chiefly employed; either natural or artificial light being available for our purpose. The light is very commonly concentrated and intensified by means of lenses or mirrors.

The student should bear in mind that it is not the object which is magnified, but merely the image impressed upon the retina. The rationale of this enlargement may be briefly set forth as follows:—Let a single lens, convex on both sides, be used to examine an object so small as to be just perceptible at the ordinary distance of distinct vision, say nine or ten inches from the eye. The eye, the lens, and the object being in their proper relations to each other, the rays of light coming from the object will so converge in passing through the lens as to form a distinct image upon the retina; in other words, the object will be seen by the eye as if it were an object of much greater size, placed at the point of ordinary distinct vision. When this occurs, the object is said to be *in focus*. The space thus presented to the eye is called the *field*.

In a single lens the rays of light towards the circumference of the field are always prismatically colored to a greater or less degree, this being very marked in what is known as the Stanhope lens; and portions of the image will also be indistinct, from the fact that by such a lens all the rays are not brought to foci equally distant from the eye. These two phenomena are called, respectively, *chromatic* and *spherical aberration;* they are to a great degree obviated in the Coddington lens, which is composed of a sphere of glass, having at its equatorial line a deep groove, filled with opaque matter, by which means the central aperture is limited.

Now, as was before stated, all our means for obtaining magnified views of objects are based essentially on the same optical principle, namely, the refraction of light. The microscopes ordinarily used are of the kind called *double*, which means that the image of an object, magnified by a lens or set of lenses, is again magnified before it reaches the eye. Here let it be distinctly understood that a *single* microscope may consist of any convenient number of lenses, provided they form but one set. The lens or set of lenses forming the first magnified image constitute the *object-glass*, and are so arranged as to obviate the chromatic aberration before alluded to. The *eye-piece* consists of a lens or *eye-glass*, by which the image transmitted by the object-glass is again magnified, and of another lens at some distance below the eye-glass, in order so to change the direction of the rays as to allow more of the object to be seen at once—in other words, to enlarge the field—whence it receives the name of *field*-glass; between these two glasses is placed a *stop* or *diaphragm*, with a central aperture, for the purpose of arresting the circumferential rays, and thus correcting both the spherical and the chromatic aberration. The eye-glass, diaphragm, and field-glass, fastened in their proper relative positions in a tube, thus constitute the *eye-piece*, which fits accurately into another tube; at the lower end of which tube is secured the one holding the object-glass, and these three portions, the eye-piece, the object-glass, and the tube into which they both fit, constitute the *compound body*. In the manufacture of microscopes, the proper relation of all the parts is ascertained upon optical principles, that is, the instrument is said to be *corrected;* sometimes, in order to compensate for certain conditions, it needs *over*-correction, and sometimes, again, it needs *under*-correction. The compound body, thus constituted, itself fits into a tube connected with the stage of the microscope; this latter tube and the stage being either fixed vertically, or capable of oblique inclination by means of a cradle-joint. The *stage* just mentioned is a plate upon which the specimen to be examined is laid, as will be presently stated. The stand of the microscope is that portion which supports the stage and compound body; it must be somewhat heavy, so as to give firmness to the instrument. The annexed cut, fig. 97, represents an excellent pattern for a microscope; it is known as the "Smith and

Fig. 97.

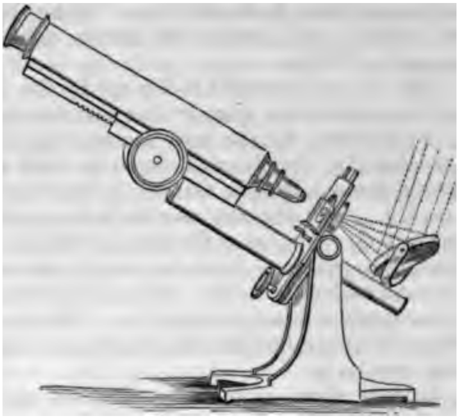


Smith and Beck's large compound microscope.

Beck," and combines great strength and steadiness with facility of manipulation.

Objects are studied by transmitted or reflected light; in the former case a mirror is placed below the stage, which is of course perforated, and the mirror is movable around one or both of its horizontal diameters, so as to catch light from any required quarter, and throw it up through the aperture in the stage, and through the object, as in fig. 98. If reflected light is to be used, the opening in the stage is closed up, and a double convex lens, or "bull's eye," is employed to concentrate the light upon the object.

Fig. 98.



Arrangement of microscope for transparent objects.

It is necessary in examining objects by transmitted light, to be able to limit the amount of light coming from the mirror; every microscope should therefore be provided with a diaphragm-plate below the stage. This is a metallic plate, perforated with holes of different sizes, so arranged as to pass in succession under the opening in the stage, when the plate is rotated.

The alteration or adjustment of the focus is variously performed in different microscopes. In some the compound body is acted on by two milled heads, one large, with a rack and pinion movement, named the *coarse* adjuster; the other smaller, with a screw movement, called the *fine* adjuster. In others the compound body is worked up or down merely with the hands, and the stage is made movable by means of a screw with a milled head.

Various methods are also adopted for moving the object so as to bring different portions of it into the field. Sometimes the fingers alone are used; sometimes a lever and universal joint, or a set of screws, acting upon the stage so as to carry it in any desired direction. Although very convenient, these appliances, as well as those for the adjustment of the focus, are not absolutely necessary, the fingers acquiring a great degree of dexterity by practice.

Nothing has as yet been said of the preparation of the specimen. The methods of doing this may be divided into two, according as the object is mounted *dry* or *wet;* the latter being the one almost exclusively adopted in our ordinary examinations, which are, moreover, almost always conducted by means of transmitted light. Generally a very small portion of the substance is placed on a glass slide, moistened with a drop of water, and covered with a strip of extremely thin glass. Some microscopists prefer to use, instead of water, a solution of gum, sugar, or phosphate of soda, of a specific gravity of about 1030; this is intended to prevent endosmotic changes in the tissue. When a liquid, such as blood, chyle, milk, or urine, or a mass composed of separate cells, is examined, it suffices to put on the fine glass cover, perhaps with a slight degree of pressure, to obtain a suitably thin layer for study. Fibrous textures require tearing apart with needles, and so also do the cells of certain growths, such as the epitheliomata. Bony and cartilaginous tumors, and also some glandular ones, are displayed to better advantage in thin sections.

Great importance should be attached, in all these researches, to the perfect cleanliness of the glass slides and covers, to the purity of the water or other liquid used, and to the freedom of the object from any foreign matters. Curious mistakes have sometimes been made from want of care in these respects; and, with a view of still further guarding against error, it is well for the observer to become acquainted with the shape and appearance of such impurities as are liable to be met with. Hairs, animal and vegetable, animalcules, air-bubbles, and portions of articles taken as food, are perhaps the most common of these.

Less fatigue is caused to the eye by the use of a microscope which can be inclined somewhat, than by one which is fixed in the vertical position; and it is important, for the same reason, that the habit should be acquired of so concentrating the attention upon the field of the instrument that the unemployed eye need not be closed; in this way much straining of both organs is avoided. Any one who uses the instrument frequently, will find it to his advantage also to employ the same powers as much as possible; thus enabling himself to estimate more accurately the comparative sizes of the elements brought under his notice, without the trouble of a calculation except where great exactitude seems called for. The best powers for habitual use may be chosen between 300 and 450 diameters; higher ones than these are very seldom necessary.

Certain chemical reagents are often applied to objects under the microscope, their effects in many cases affording valuable information as to structure and composition. *Iodine*, dissolved in water by means of iodide of potassium, turns starch blue. *Nitric acid* gives a marked yellow color to animal textures generally; either this or *hydrochloric acid* diluted, or a combination of the two, will remove the calcareous portion of bone or tooth. *Alcohol* renders nerve-fibres and other animal tissues more opaque, and therefore more evident. *Ether* removes fatty matters, except when they are enveloped in an albuminous covering. *Potassa* and *soda*, in solution, have each of them a solvent effect on certain animal textures. But the reagent perhaps oftenest employed is *acetic acid*, which brings out, in a remarkable manner, the nuclei so commonly possessed by organic cells, by rendering the cell wall transparent.

When a specimen of any kind cannot be at once subjected to microscopical examination, it should be kept in pure water, slightly alcoholized and frequently renewed; in this way its characters will not be changed, as they would be either by the action of strong alcohol or by decomposition.

Let us now inquire in what branches of surgical science the investigation by the microscope of morbid changes, deposits, and processes can be made practically useful. We may, in the first place, exclude prognosis and treatment, which can only be indirectly influenced by this mode of study. Etiology is likewise to be thrown out, for reasons which can be readily illustrated by an instance. Thus, the itch insect cannot be assumed to be the cause of the disease, in cases in which it is found, for we cannot prove that its presence is not a mere epiphenomenon. Pathology and diagnosis are the departments most indebted to the microscope for their advancement. They are of course very closely related to one another, and of great practical importance; and as we are at present especially concerned with them in this combined aspect, we have nothing to say in regard to inflammation, nor to the repair of injuries, however deserving of attention these subjects may be in their appropriate place.

The use of the microscope affords much light in regard to *material* pathology; it shows us the changes in texture, and the adventitious deposits, which accompany or constitute disease. Hence it is at once evident that, great as its value may be, as an auxiliary, it cannot possibly set aside other modes of observation; the results of clinical experience must in every case be as carefully weighed as if we had nothing else to depend upon; otherwise we shall not only fall into grave errors, but depreciate the scope and dignity of surgical science. Nor can it be denied that there are some questions which are entirely beyond the range even of the assisted eye; let any one, for instance, examine under the microscope portions of pus from a chancre, from a urethra affected either with gonorrhœa or with simple inflammation, and from a common boil; that there exist certain essential peculiarities in each of these no one will deny, but to detect those peculiarities by this means no one need attempt.

The great question in microscopy discussed at present by all pathologists is, whether there is any distinctive and characteristic element in the so-called *malignant* deposits, by which they may be at once recognized. At one time the caudate cell was thought to constitute evidence of malignancy; at another, the large nucleus; at another, the double or the vesicular nucleolus; again, the multiplicity of cell forms; and finally, the existence of malignant tumors, as a class possessing distinct form-elements, has been practically, if not expressly, denied.

An attempt is even now being made, by certain German pathologists, to show that cancer and tubercle—the latter of which is, in fact, as properly malignant as any other growth—are merely abortive attempts at cells of a healthy character; tubercle cells being considered as nuclei merely. Any discussion of this view would be out of place here, and mention is made of it simply in order to show that opinions are still at variance in regard to the true theory of morbid growths. It is certain that many tumors recur again and again after removal, which do not present the microscopical appearances of cancer as described by most authors. It is no less certain that some tumors which do present such appearances have been successfully excised; at least the subjects of them have died without any fresh evidence of malignant disease.

Nevertheless, it is by no means certain that there is not a distinct and specific cancer cell; but this cell must present different forms in different cases, or even in the same case.

Caudate cells do not signify a malignant character in the growth containing them. All tissues of new formation are apt to have them in greater or less proportion; some tumors are composed of them entirely. Connective or areolar tissue, and old cicatrices, always contain them.

Nor can any form of nucleus or nucleolus, nor any number of nuclei or nucleoli, be assigned as indicative of malignancy. Pus cells generally possess two or three nuclei; fibro-plastic or fibre-forming cells often show two or more nucleoli.

On the other hand, there are assuredly circumstances under which the testimony afforded by microscopic examination is by no means unimportant, and is confirmed by subsequent events. For instance, an isolated tumor, apparently composed of areolar tissue, involved the submaxillary gland of a patient; upon its removal it was examined beneath the microscope, and found to contain cells of various shapes and sizes, some very much elongated, and all with large nucleolated nuclei; it was pronounced malignant, and reappeared within three weeks. Again, a case occurred in which the diagnosis was somewhat doubtful between cancer and menorrhagia; the former idea was shown to be correct, by the discovery in the discharge, under the microscope, of cells of extremely various sizes, caudate, elongated, and round, with large single or double nuclei; some of the cells contained also young cells. Such elements, observed in the discharge from a diseased bladder or rectum, would constitute evidence of malignant deposit in the organ.

There are cases, moreover, in which a knowledge of the microscopic structure of a tumor may enable us to allay the most painful apprehensions on the part of the patient; thus, a growth occurring in the female breast may be shown to consist simply of a hypertrophied portion of the gland, and therefore to be destitute of any malignant character.

In order to draw any positive inference from microscopic observations, the growths or tissues examined should be carefully scrutinized, and in many instances several different portions of them subjected to separate study. Thus, a hypertrophied lobe of the mammary gland may perhaps contain a deposit of a decidedly malignant character, and this fact may entirely escape notice in a partial or hasty examination; so also bony and cartilaginous deposits are apt, when found in connection with the soft tissues—such, for instance, as the testicle—to be associated with less innocent formations.

Another no less important precaution, for the credit of microscopy, should not be forgotten. We may assert of a particular tumor that it presents no sign of malignancy; but we cannot therefore declare that the individual from whom it has been removed is exempt from cancer. He may be already the subject of a carcinomatous diathesis, which will reveal itself at some future time, perhaps at the very same point rendered more vulnerable by the substitution of cicatricial for normal tissue. Coincidences of this kind have undoubtedly been adduced as proof of the insufficiency of the information afforded by the microscope.

The best guide, in the present state of our knowledge upon this subject, is experience; the beginner will often find himself entirely at a loss, and unable to make up his own mind in regard to particular cases. No argument is necessary to set forth the imprudence of a rash decision under such circumstances; both diagnosis and prognosis should be withheld until further observations can be made.

It is by no means uncommon for the surgeon to be in doubt as to the character of discharges taking place from some of the outlets of the body; and in clearing up these points the microscope may render essential service.

The *saliva* will often be found to contain altered epithelial scales, and various parasitic sporules and filaments, indicating derangement of the mucous membrane of the mouth.

The *sputa* may be examined with benefit in some cases of doubtful pulmonary disease; the presence of the peculiar corpuscles of tubercle, or of fibres from the parenchyma of the lung, indicates phthisis, while that of cancer cells would denote cancer of the lung. Care is necessary in these cases to avoid mistaking the free nuclei of cancer for tubercle corpuscles; an error which may have been committed by those who have asserted the coexistence of the two forms of disease in the same subject. Parasitic plants are sometimes found in the sputa, especially in cases of tuberculous disease; they are probably accidental only. Occasionally an opening is formed in the diaphragm, through which parasitic animal growths find their way from the liver into the air-passages; thus, the hooklets of the *echinococcus* have been expelled by coughing. Fibrinous casts of the smaller bronchial tubes are often met with in pneumonial sputa. All these substances must be distinguished, not only from one another, but also from particles of foreign matter, such as food adhering to the teeth, which may seriously mislead the observer.

Vomited matters present some interest. They consist usually of undigested food, with portions of epithelium, but in some diseases they contain also special ingredients. Blood, pus, cancer cells, and sarcinæ are the chief of these.

The examination of the *urine* microscopically is elsewhere discussed; that of *fecal matter* has some importance in cases of supposed cancerous disease of the rectum, in cholera, melæna, and some other morbid states. This subject has received too little attention, especially when its physiological bearing is taken into account. Here, also, care is requisite, lest particles of undigested food, parasitic growths, or other substances, should give rise to serious errors in theory or in diagnosis.

Uterine and vaginal discharges have been before alluded to; their microscopic study is chiefly important in the diagnosis of cancer, tubercle, and other morbid deposits.

Milk is sometimes to be judged of by its microscopic characters; its colostral characters—the compound granular bodies and the variability in the size of its oily particles—should disappear by the fifth or sixth day after parturition. In order to compare specimens of milk, it is evident that the drops examined should be of the same bulk, and the thin glass cover made to press equally, in each case.

Blood, examined under the microscope, is sometimes found to contain an abnormally large proportion of white corpuscles; a condition known under the name of leucocythemia. It must be acknowledged that we have as yet by no means appreciated the importance of the changes undergone by the blood in disease.

It is occasionally of great practical moment to determine whether certain fluids or secretions, as mucus, urine, milk, or semen, furnished by an organ laboring under disease, contain *pus*, inasmuch as the presence or absence of this fluid may not only throw great light upon the diagnosis of the case, but lead to important therapeutic indications, perhaps the avoidance of a serious operation, as, for example, the amputation of a limb in the case of granular degeneration of the kidney. The most satisfactory test, undoubtedly, of all is the globular character of the pus, as revealed by the microscope, perfectly healthy mucus having no such bodies. It is only when mucus is derived from an irritated or inflamed surface that it presents corpuscles, which may then consist either of undeveloped epithelial cells, lymph corpuscles, or pus globules. Pus and pus liquor are highly albuminous, and therefore readily coagulable by heat, alcohol, and acids; healthy mucus, on the contrary, contains no pus liquor, and is therefore not coagulable. If the suspected secretion be agitated with a solution of potassa, it will, if purulent, be converted into a dense, gelatinous mass, but not if it consist of mucus. Mucus, treated with acetic acid, coagulates into a thin, membranous pellicle; pus does not. Subjected to the contact of ether, mucus yields no traces of fat, whereas this substance may always be extracted in considerable quantity from pus, especially if at all pure. Finally, mucus floats in water; pus, on the contrary, sinks in it.

Further observations on the distinction between pus and other fluids will appear in the chapter on the urinary organs, so as to render, for the present, any other remarks here unnecessary.

The surgeon is not unfrequently called upon for *medico-legal* information; and here the microscope may be of essential service, as, for instance, in the detection of blood-stains, or of spermatozoids in and about the vagina in cases of alleged rape. Facts of great importance have in this manner been established.

All microscopic examinations should be recorded, and drawings made of any notable appearances observed; in this way alone can permanent additions be made to the fund of knowledge possessed by the individual or by the profession at large.

CHAPTER XIII.

MINOR SURGERY.

Minor surgery comprises an account of some of the more common instruments used in surgery, of the mode of making incisions, or of performing the elementary operations, the establishment of issues, the introduction of the seton, the application of the actual cautery, bleeding, and the art of bandaging and of dressing. As some of these topics have already been incidentally discussed, especially in the chapter on inflammation, I shall here confine myself to the consideration of those that have not yet been touched upon in previous parts of the work.

SECT. I.—INSTRUMENTS.

Instruments are as necessary to the surgeon in the execution of his operations as they are to the mechanic in the performance of his daily labor. But as the best workman employs the fewest tools, so the best operator employs the fewest instruments; and to the man of science and taste nothing is more disgusting than an ostentatious display of such material. A few articles, well selected, and kept in proper order, ready to do their work at the shortest notice, are all that any surgeon really requires for the successful performance of nearly every operation that he may be called upon to undertake. The simplicity of his armamentary often affords a better idea of his skill and science than the most daring feat upon the operating table.

The elementary and really important instruments are very few in number; they are the scalpel, needle, saw, forceps, probe, and director, which are the parents of nearly all the numerous and diversified surgical contrivances found in the shops of the modern cutler. With a little modification the scalpel is converted into the bistoury, the lancet, and the amputating knife, and may be thus made to answer all the purposes required of a cutting instrument. The same needle with which a suture is made may, with a little difference of size and shape, be readily used for couching and lacerating a cataract, or inserting a seton. The saw may be modified without limit, and the same is true of the forceps, whether intended for dissection, dressing, or the division of bone. The probe, which, from its great usefulness, may almost be regarded as another finger, varies in size and shape, from the little delicate, almost thread-like instrument devised by Anel for examining the lachrymal canal, to the sound employed by the lithotomist for exploring the condition of the bladder. The grooved director, which serves to guide the knife in the division of the soft parts, as in operations for hernia, impermeable stricture, and stone in the bladder, is, in fact, nothing but a modification of the ordinary probe.

The *knives* generally in use among surgeons for the more ordinary daily operations are the scalpel and bistoury, of various sizes and shapes, so as to adapt them to the exigencies of each particular case. All such instruments should have a tolerably large handle, and I decidedly prefer one that is somewhat rough, as being less likely to slip from the fingers when it becomes wet with blood. The blade should be rather long and slender, gradually tapering to a point, which should be quite sharp, or, at any rate, not at all rounded. In some operations, a double-edged, spear-shaped knife is found serviceable, as in the extirpation of tumors, and the extraction of the cataract. Finally, it is sometimes advantageous to have a knife whose handle terminates in a semi-sharp steel edge. Such an addition is occasionally of great service in the extirpation of tumors. The annexed figures afford a good idea of the more common forms of scalpels.

Fig. 99.

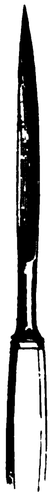


Fig. 100.

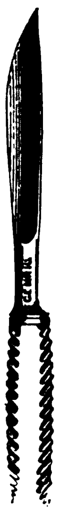


Fig. 101.

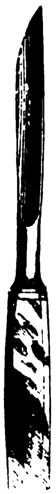


Fig. 102.

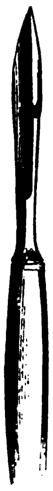


Fig. 103.

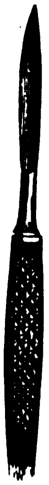
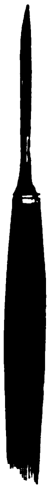
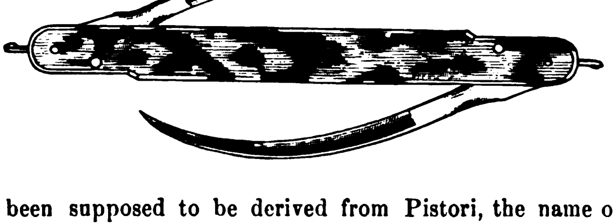


Fig. 104.



The *bistoury* differs from an ordinary scalpel chiefly in being longer and more slender; it may be straight or curved, with a sharp or blunt extremity. It is often made so as to open and shut like a penknife, as in fig. 105; but the best instrument of the kind is one with a fixed handle. The term bistoury has been supposed to be derived from Pistori, the name of a town where it was at one time extensively manufactured. Particular forms of this instrument, invented for particular operations, will be alluded to in different parts of the work.

Fig. 105.



The adjoining sketches afford good illustrations of the ordinary forms of the bistoury; fig. 106 represents the sharp-pointed instrument, and fig. 107 the probe-pointed.

Fig. 106.

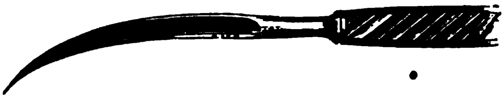
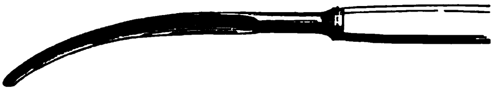


Fig. 107.



There are hardly any operations in which it is not necessary for the surgeon to avail himself of the use of *forceps*. The instrument usually employed is the common dissecting-forceps, represented in fig. 108. In some cases, as when the object is to pinch up a delicate structure, as the conjunctiva, or a very thin layer of fascia, a pair of forceps provided with a small side-prong, pointing inwards, as represented in fig. 109, will be found very convenient.

Fig. 108.

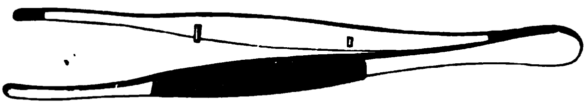
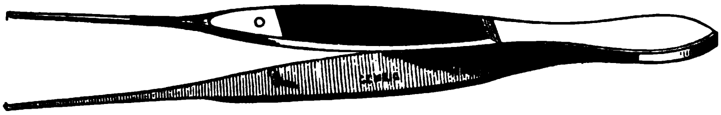


Fig. 109.



Scissors are nothing but two knives united by a screw, and furnished each with a ring-handle; if thin, and properly sharpened, they divide the tissues with little or no contusion, and may be employed for a great variety of purposes. They are particularly valuable in many of the more delicate opera-

Fig. 110.

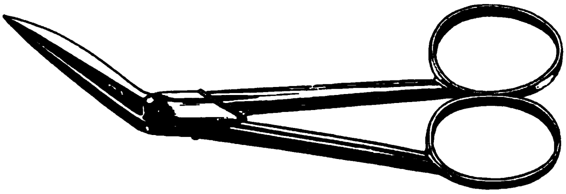
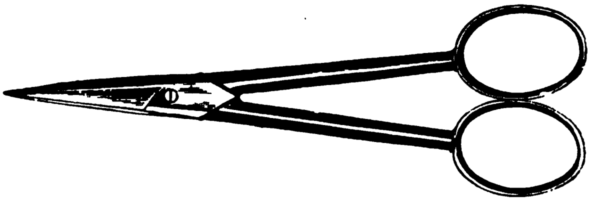


Fig. 111.



tions upon the eye. They may be straight or curved on the edge or on the flat, pointed or blunt at the extremity, or one blade may be sharp and the other blunt. The annexed drawings exhibit the two principal forms of scissors used by the surgeon.

For holding the flaps out of the way in performing certain operations, especially such as involve the removal of morbid growths, among the more deep-seated structures, or the exposure of arteries, instruments, called retractors, are often of great service, and should find a place in every well arranged operating case.

For holding and pulling out morbid growths, such as deep-seated tumors of the neck or thigh, and for drawing down the cervix of the uterus in operating for vesico-vaginal fistule, as well as for other purposes, a Museux's forceps, shown in fig. 112, or a common volsella, is often of great use. The teeth being plunged into the morbid mass, the instrument is either held by the surgeon himself, or the requisite traction is exerted by an assistant. Fig. 113 represents another contrivance, which may be used for a similar purpose, its prongs being firmly screwed into the substance of the morbid growth.

Fig. 112.

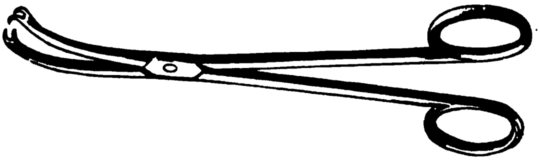
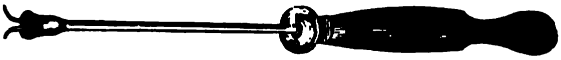


Fig. 113.



The forceps shown in fig. 114 is very serviceable in the extirpation of large polyps of the uterus.

Fig. 114.

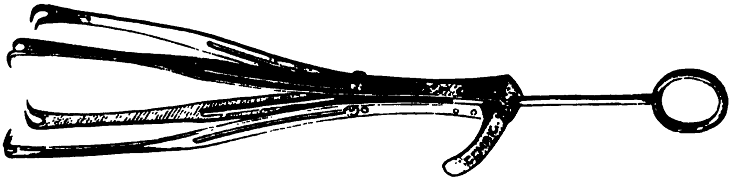
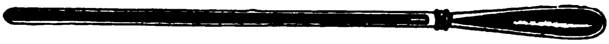


Fig. 115.



The grooved *director*, sketched in fig. 115, is of great service in laying open sinuses and fistules, in exposing arteries, and in dividing the coverings of herniæ, and of deep-seated tumors. It is generally blunt at the extremity, but in some cases it is found more convenient to have it somewhat sharp, so as to effect more easy penetration of the tissues.

The *trocar*, represented in fig. 116, and so called from the circumstance of having a three-edged extremity, consists of a cylindrical rod, passed through a silver canula. It is employed for drawing off various kinds of fluids, as serum and pus. Its use, at the present day, is chiefly confined to the removal of water from the chest, abdomen, and vaginal tunic of the testicle. There is an instrument of this kind with a flat, spear-shaped extremity, but it is not much employed, its canula being more liable to obstruction than that of the round trocar.

Fig. 116.

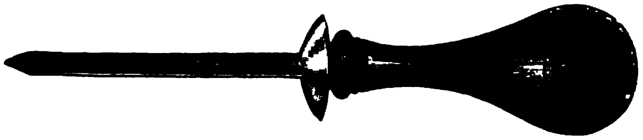
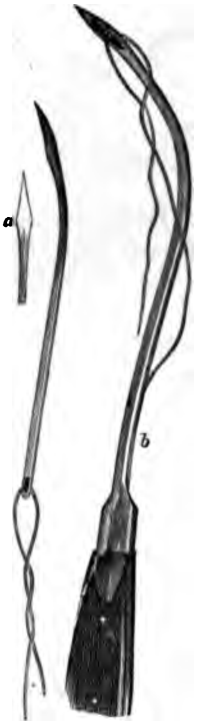


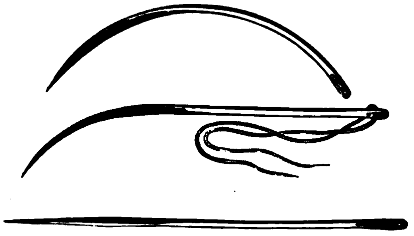
Fig. 118.



Suture needle; with improved point, *a*. *b*. Needle in fixed handle; useful in tying erectile and other tumors.

There are few instruments which the surgeon has occasion to use more frequently than *needles;* they may be straight or curved, round or flat, and should be of various sizes, as in Fig. 117. In some instances, as when we are obliged to take a deep stitch, sew up a fissure of the palate, penetrate an unusually hard structure, or encircle a deep-seated artery, it is convenient to secure it to a handle, as in fig. 118.

Fig. 117.

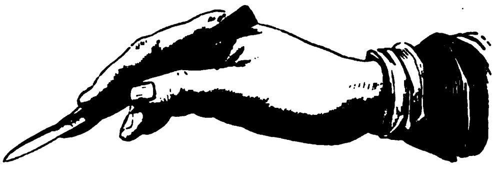


SECT. II.—INCISIONS.

It is not my intention to enter into any minute details respecting the manner of holding the knife, in operating upon the living subject, as this is a kind of information which should be acquired in the dissecting-room, in connection with the study of surgical anatomy. A few rules, concisely and plainly stated, will be quite sufficient for the purpose, and will enable any man of sense to execute, with facility, neatness, and dispatch, any operation he may be called upon to undertake. Anything like a flourish for the sake of display or the hope of attracting the applause of the vulgar, is as repugnant to good taste as it is out of place upon such an occasion.

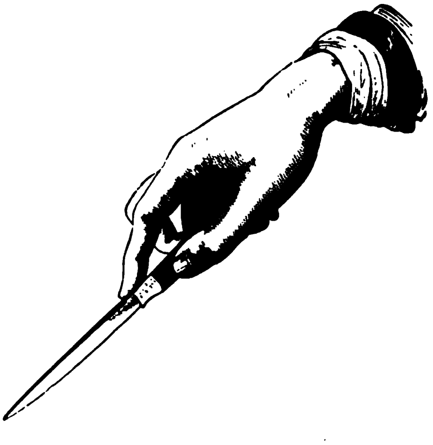
There are four principal positions in which the knife may be held for operative purposes, and with these every surgeon should make himself familiar. The annexed sketches will serve to convey a better idea of their character than any description however elaborate. They are generally distinguished by the prefix of first, second, third, and fourth.

Fig. 119.



In the *first position*, fig. 119, the knife is held like a writing-pen, between the thumb and the first two fingers, which grasp the instrument gently yet firmly at the junction of the handle with the blade, the edge being inclined downwards or upwards according to the intentions of the surgeon. This position is a very common one, as it is employed in a great variety of operations, as lithotomy, the extirpation of tumors, herniotomy, and the extraction of the cataract.

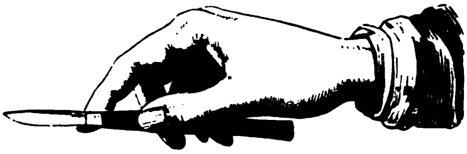
Fig. 120.



In the *second position*, fig. 120, the handle of the instrument lies in the palm, the thumb and middle finger holding it at its anterior extremity, while the index finger is slightly extended along the back of the blade, the ring and little fingers assisting in supporting and steadying the handle. The edge of the blade is inclined downwards or upwards, according to circumstances.

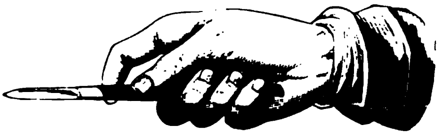
In the *third position*, fig. 121, the knife is held like the bow of a violin; that is, the instrument, turned away from the palm, is lightly balanced in the hand, the four fingers being applied against one side, and the thumb against the other. In the dissection, the blade is usually held somewhat sidewise, and the operation is performed chiefly by alternately flexing and extending the wrist.

Fig. 121.



In the *fourth position*, fig. 122, the knife is held like an ordinary carving-knife, the handle, which inclines towards the ulnar margin of the wrist, being firmly grasped by, and almost

Fig. 122.



completely concealed in, the hand, the tips of the last three fingers nearly touching the hypothenar eminence. This position is chiefly used in the amputation of the larger limbs, and, occasionally, in the extirpation of huge superficial tumors, when the surgeon wishes to produce a rapid and brilliant effect.

The *incisions* employed in operative surgery may be conveniently reduced to three principal ones, namely, the straight, curvilinear, and angular, which are the parents of all the rest. In executing these incisions certain rules should be observed, of which the most important are the following:—

1st. The knife, whether it be a bistoury or scalpel, should be in as complete a condition as possible, being perfectly sharp and clean, and as light as may be consistent with the necessary strength; its size should also be carefully adapted to the occasion.

2d. Before commencing the incisions, care should be taken to stretch, extend, or tighten the skin, which is done either by the operator alone, or partly by him and partly by his assistants. Attention to this rule is of great importance in numerous operations, as it not only expedites the movements of the knife and imparts precision to the incisions, but, what is often a matter of the greatest consequence, enables us to save integument, as, for instance, in case of amputation.

3d. The incisions, whatever be their shape, should be sufficiently large to answer the purpose for which they are designed, being made so, if possible, before the dissection is begun, as this generally greatly facilitates the removal of the parts, or their separation from each other. The principal exception to this rule is where the operation involves the division of large vessels, which, if they were all wounded at once, might be productive of serious hemorrhage.

4th. The superficial incisions should be of equal depth throughout, the knife being entered perpendicularly at one extremity, and brought out similarly at the other, the object being to avoid the formation of what is called a tail, or a partial division of the integuments at each end, as will inevitably happen when the point of the instrument is introduced obliquely. A gentle but steady sawing motion of the knife should be employed rather than firm pressure.

5th. In dividing the common integuments, the knife should always, if possible, be carried parallel to the axis of the part to be exposed or removed, in order that there may be no interference with any important vessels or nerves, which usually run in that direction. Another great point to be gained, in observing this precaution, is that we prevent the flaps from bagging, and so serving as receptacles for the lodgment of blood and inflammatory deposits.

6th. The incisions should be made as rapidly as possible, seeing that the division of the common integuments is generally the most painful part of an operation. Moreover, while they should be sufficiently extensive for the object in view, care should be taken not to make them larger than is necessary.

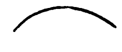
7th. All cutaneous incisions should be made with special reference to the prevention of unseemly scars. To do this successfully is not always either easy or even practicable. As a general rule, the object is best attained by carrying the knife in the direction of the muscular fibres of the part, or in the line of its wrinkles. Thus, in operating on the forehead, the surgeon will best attain his wishes if he makes his incision horizontal, not oblique, much less perpendicular. In operating upon the lower jaw, or in extirpating tumors from this region, the incisions should be so directed as to run along the base of the bone which will thus offer the best chance of concealing the resulting cicatrice.

8th. The operator, in the exercise of his functions, must be careful not to wound himself, his assistants, or his patient; an occurrence as awkward as improper, and one that will seldom happen if everything is properly arranged beforehand.

The straight incision may be made either from without inwards, or from within outwards. The former method is usually adopted in the ordinary operations, as in the extirpation of tumors, in opening abscesses, and in the ligation of arteries. Where great caution, however, is required, as in operating for strangulated hernia, or in the removal of morbid growths in front of the neck, the incision must be made from within outwards. For this purpose a fold of integument, being pinched up, is held by the surgeon and his assistant, while its base is transfixed by the knife, and divided by making the instrument cut its way out. The dissection is afterwards to be conducted upon a grooved director.

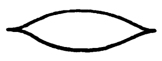
Occasionally, as in operating about the neck, especially when the object is the removal of a large tumor at the angle of the jaw, the incision may advantageously be made in a curvilinear direction, either like an Italian *f*, or in the form of a semi-ellipsis, as in fig. 123. The chief reason for this procedure is that, while it affords the operator more room, it leaves a more seemly cicatrice.

Fig. 123.



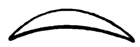
The elliptical incision consists of two curvilinear cuts, meeting at their extremities, as in fig. 124. It is chiefly employed in the extirpation of tumors, where the object is to remove along with the diseased mass a portion of redundant or unhealthy integument. The incisions are made rapidly, in the usual manner, one after the other, the skin being properly stretched, and care taken not to cut away more than is absolutely necessary, since it will otherwise be difficult, if not impossible, to bring the edges of the wound together, after the operation is over, so as to obtain a good and rapid union. Not a little judgment is frequently required to determine, in a given case, how much integument may conveniently be preserved or removed; the surgeon, remembering how contractile the skin is, will generally be cautious how he sacrifices it. Even if the flap be unseemly immediately after the operation, a few days will generally suffice to reduce it to a proper shape and size.

Fig. 124.



Two semi-elliptical, crescentic, or semi-lunar incisions, as in fig. 125, may sometimes be advantageously made, also with the object of removing a portion of integument, as, for instance, in extirpating a diseased mammary gland.

Fig. 125.



The incisions may be directed vertically, obliquely, or horizontally, as may seem most suitable. The angular incision may be used for various purposes, as in the extirpation of tumors, herniotomy, excision of joints, the exposure of diseased bone, and in the transplantation of flaps for the restoration of lost or mutilated parts. It may be made in different ways, but commonly so as to represent the shape of some letter, as in the subjoined figures, according to the exigencies of the particular case.

Fig. 126.

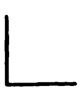


Fig. 127.

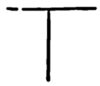


Fig. 128.

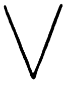


Fig. 129.

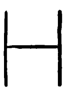


Fig. 130.

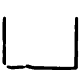
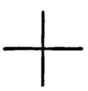


Fig. 131.



In dissecting up the flaps, made by these different incisions, the instrument should, as a general rule, be kept in close contact with the parts to be removed; the knife should be swept along as rapidly as may be consistent with safety; good use may generally be made of the fingers, which will in most cases be found altogether preferable to the forceps. Special regard should always be had to the prevention of hemorrhage. If well-trained, intelligent assistants be at hand, there will, in general, be no necessity for tying every little artery as soon as it is divided; the instant it springs, a finger is clapped upon it, and thus the operation proceeds to its completion, when, satisfactory clearance being effected, the ligation is at once promptly entered upon, and continued until every bleeding vessel is properly secured.

When the dissection involves the exposure of an important structure, as a large artery, a strangulated hernia, or an encysted tumor, which it is desirable not to pierce, the tissues must be divided layer by layer upon a grooved director gently and cautiously insinuated beneath them; or they may be pinched up with a pair of forceps, although this is both less elegant and less safe than the other method. In performing this part of the operation, the successive divisions must be effected in the line of the external incisions, the best knife for the purpose being a narrow, probe-pointed bistoury.

SECT. III.—AVULSION, ENUCLEATION, LIGATION, AND CRUSHING.

1. *Avulsion.*—Instead of cutting away morbid growths with the knife or bistoury, recourse is sometimes had to avulsion, or to twisting and tearing. It is in this way that the surgeon usually removes polyps from the nose and uterus, the instrument which is employed for the purpose being a suitable pair of forceps, with which the tumor is seized and broken off, by rotating the instrument gently yet firmly upon its axis. All active or sudden and forcible pulling is avoided, as tending to inflict serious mischief upon the parts around by lacerating and injuring them to an undue extent; or, as in the case of the nose, perhaps dragging away the turbinated bone, or, as in that of the uterus, inverting that organ, or pulling it down beyond the vulva. Moreover, by avoiding this procedure there will always, as a general rule, be much less risk of copious hemorrhage, severe pain, and shock to the nervous system.

Avulsion is sometimes advantageously practised in the extirpation of tumors developed in and among the tissues, especially when they are deeply situated, or when they lie in the immediate vicinity of large vessels, which it would be hazardous to approach with the edge or extremity of the knife. Under such circumstances, the finger may occasionally advantageously take the place of the cutting instrument, the connecting structures being forcibly lacerated, and the mass twisted and lifted out of its bed. This mode of procedure is often resorted to in the removal of tumors from the neck and parotid region dipping deeply down behind the base and angle of the jaw, in close proximity with the pharynx and the large cervical vessels and nerves, where a false movement with the scalpel might be instantly fatal. It is astonishing what little bleeding frequently follows operations thus performed, and how well the parts generally heal after such rude manipulations. One reason why there is usually so little hemorrhage is that the vessels are torn instead of being evenly divided, as they are in the ordinary procedure.

2. *Enucleation.*—Enucleation is another species of avulsion, and is often advantageously employed in the extirpation of fatty, fibrous, and fibro-plastic tumors. The integuments having been thoroughly divided over the morbid growth, along with its capsule, if there be any, the diseased structures are rapidly peeled out either with the finger, or with the handle of the scalpel. In certain cystic tumors the bag with its contents may often be peeled off bodily, or, its cavity being laid freely open, and its contents evacuated, the walls of the cyst may be pulled away with the forceps.

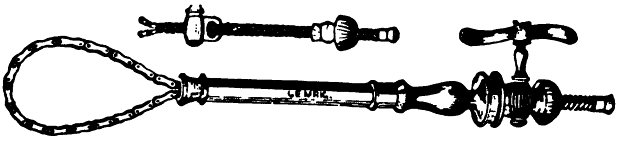
3. *Ligation.*—There are certain operations in which the removal of the diseased parts is effected chiefly through the agency of the ligature. Of this mode of procedure familiar examples are afforded in the removal of hemorrhoidal tumors, polypous growths of the nose, vagina, uterus, and anus, and in nervous formations about the face, forehead, and other regions of the body. The ligature may be applied either directly to the part by the fingers, or by means of a needle, and should be drawn with sufficient firmness to strangulate the included structures, as the object is to cut off the supply of blood, and cause an eschar. Occasionally the ligature is used subcutaneously, as in the case of nevous growths, involving often very interesting and complicated operations. Instead of the ligature, a silver wire is sometimes used, either by itself, or by means of a double canula, as in fig. 132.

Fig. 132.

Double canula.

4. *Crushing.*—Parts, again, may occasionally be removed by a process of crushing, as proposed a few years ago by Mons. Chassaignac, of Paris, the instrument which he has devised for that purpose being what he calls the *écraseur*, or crusher; the inventor hoping thus to meet certain contingencies in operative surgery which he, in common with others, had frequently encountered in practice, and which he supposed could not be overcome in any other manner. His chief object was to supply a substitute for the ligature in the removal of certain tumors, as hemorrhoids, and polyps of the vagina and uterus. The idea seems to have been to contrive an instrument that should combine the security of the ligature with the rapidity of the knife, thus preventing hemorrhage and pain, and promptly ridding the part of abnormal structure. The écraseur, as might be supposed, was originally rude and clumsy, but, by the ingenuity of surgeons and cutlers, has been rendered very graceful and convenient, if not absolutely perfect. The annexed sketch, fig. 133, affords an excellent representation of the shape and construction of the instrument, as manufactured by Gemrig, Kolbe, and others of this city. It will be perceived that it essentially consists of two pieces, a sheath, barrel, or tube, either flattened or cylindrical, and of an articulated chain, attached to a steel rod, lying within the sheath, and moved by a handle. The chain is constructed upon the same principles as in the ordinary chain saw, but the links are stronger, and perfectly obtuse, except when it is desired to combine division with crushing, in which event their edges are somewhat beveled. The instrument is made of various sizes and shapes, so as to adapt it the more readily to the various cases presented in practice. The chain, unless constructed with great care, is very liable to break, especially if used for the removal of dense, indurated structures, the division of which requires a good deal of force.

Fig. 133.



Ecraseur.

The application of the écraseur has recently been very much extended, and it is quite impossible to foresee where, in the hands of its admirers, it may ultimately cease. During the last twelve months the journals have been filled with accounts of all kinds of wonderful achievements of this instrument, even including amputation of the arm and thigh by its inventor; while its more moderate and less enthusiastic partisans are content with restricting its use to the removal of various kinds of tumors, especially hemorrhoidal, nevous, and ovarian, and the tongue, penis, prepuce, and neck of the uterus. The advantages claimed for it are, first, the rapidity of the operation, which is greater than that with the ligature, although less than with the knife, the instrument acting more powerfully upon the tissues embraced in its loop; secondly, the prevention of shock, the chain doing its work gradually and almost imperceptibly, so as hardly to afford the system an opportunity of taking cognizance of what is going on; thirdly, the protection of the part against hemorrhage, the vessels being placed in a condition similar to those in a lacerated and contused wound; and, lastly, the making of a smaller and less exposed wound than either the ligature or knife, and, consequently, less inflammation and a more rapid cicatrization.

The principal rules to be observed in the application of the écraseur are the following: In the first place, if the tumor has a broad base, it should, if possible, be pediculated, by drawing it away from its points of attachment, and casting a ligature around it, its base having been previously transfixed by one or two stout needles. When the coverings of the morbid growth are unusually hard, or insensibly lost in the surrounding parts, a gutter may be formed in them with the knife, preliminary to the application of the chain. Secondly, the division of the tissues is to be effected slowly and gradually, not rapidly or by fits and starts, and for this purpose the handle of the écraseur should be turned only about once every ten, twenty, twenty-five or thirty seconds. The time occupied by the entire operation must of course vary according to circumstances, from five minutes, as the average minimum, to twenty minutes, as the average maximum. The great objection to a rapid operation is the danger of hemorrhage. Thirdly and lastly, the patient, during the whole procedure, should be under the influence of an anæsthetic, otherwise the pain will be extreme, especially in the earlier stages.

The subsequent treatment is very simple. If pain arise when the patient wakes from the effects of the anæsthetic, a full anodyne is given, the part is kept at rest in an elevated position, under the influence of water-dressing, and any constitutional symptoms that may show themselves are met as they occur, just as after any other operation. The wound generally heals in a very short time, with very little appearance of inflammation. I am not aware that the application of the écraseur has ever been followed, in cases at all adapted to its use, by pyemia, or any grave constitutional effects, and this is certainly one of the strongest arguments that can be urged in favor of its employment.

The écraseur is one of those novelties whose use is always, at first, followed by great abuses, which time alone can rectify. The indiscriminate employment which characterizes it at the present moment is only calculated to bring it into disgrace, by arraying against it the prejudices of the more calm and enlightened members of the profession. When it shall assume its legitimate rank, which it must do before long, it will cease to be applied to the amputation of the limbs and of the mammary gland, if not also of the penis and testicle, and will be restricted, in great measure, if not entirely, to the removal of the tongue, the neck of the uterus, and hemorrhoidal, erectile, and polypous tumors of the vagina and uterus; but even in these affections it will not always supersede the use of the ligature. In internal piles, for instance, I should certainly myself prefer the ligature, and in polypous growths the most eligible operation will generally be avulsion.

SECT. IV.—ABSTRACTION OF BLOOD.

Abstraction of blood may be effected by scarification, puncture, incision, leeching, and cupping. The fluid is sometimes taken from a vein or an artery; the operation, in the former case, constituting venesection, and, in the latter, arteriotomy.

1. *Scarification.*—Scarification is performed with the lancet, scalpel, or bistoury, passed lightly and rapidly over the inflamed surface, so as to divide the engorged vessels, and afford them an opportunity of freeing themselves of their contents. It is employed chiefly in conjunctivitis, tonsillitis, erysipelas, and irritable ulcers, and may be repeated once a day, or once every other day, according to the exigencies of the case, the bleeding being promoted by the liberal use of warm water. In irritable ulcers of the extremities as well as in other parts of the body, scarification is an exceedingly useful practice, which I have pursued, for many years, with great advantage. The proper mode of proceeding is to immerse the limb, previously constricted just below the knee, in a vessel of warm water, and then to make from four to eight vertical incisions over the sore, extending merely through the superficial portion of the true skin. In this manner I have repeatedly bled my patient to syncope, making thus a most salutary impression both upon the part and system. In granular conjunctivitis, the eyelids, especially the upper, may often be scarified with the happiest effect; and in ophthalmia, attended with chemosis, deep incisions are generally practised to relieve engorgement and prevent strangulation of the vessels of the cornea. In tonsillitis, scarification nearly always greatly mitigates the symptoms, and in erysipelas, especially the phlegmonous variety of that disease, it forms a most important element of the local treatment, nothing else being so well calculated to remove tension and prevent gangrene.

2. *Puncturing.*—Puncturing is performed pretty much with the same intention as scarification. It is particularly valuable in erysipelas, active œdema, boils, carbuncles, hemorrhoids, and affections of the tonsils, uvula, lymphatic glands, scrotum, prepuce, uterus, labia, and nymphæ, its beneficial effects depending upon the amount of drainage which follows the operation. The best instrument for performing the operation is a very narrow, sharp-pointed bistoury, thrust rapidly into the inflamed surface, to a depth varying from a line to half an inch, according to the degree of swelling of the affected parts, care being taken to avoid injuring important vessels and nerves. In phlegmonous erysipelas, as many as fifty, seventy-five, or even a hundred punctures may sometimes be made with advantage.

3. *Leeching.*—Leeching is applicable to a great variety of affections, and is perhaps more frequently employed than any other mode of topical bleeding. The operation, however, is not without pain, and, unless properly performed, may even be followed by danger. Thus, in epidemic erysipelas, I have known it to give rise to an attack of this disease, which speedily destroyed the patient. Sometimes, again, leech-bites degenerate into bad sores, and produce a great deal of constitutional irritation. Ill effects will be most likely to arise when the leeches are sickly, and when they are applied to persons of a nervous, irritable temperament. Hence, great caution should always be exercised in their selection, as well as in the manner of using them.

The best leeches are the Swiss, German, French, and Spanish, which generally take hold with great avidity, and draw each from half an ounce to six drachms of blood, including what flows after the animal drops off. The American leech, although much larger than the European, bites reluctantly and sucks sluggishly, on which account it is now rarely used. Mo wound made by the foreign leech emits four times as much blood as that made by the native; a fact not to be lost sight of in ordering this kind of bleeding. Whatever species be employed, the rule is to divest the part of hair and dirt, otherwise the animal will either not take hold at all, or only after much coaxing, its tastes and habits being extremely fastidious. If, notwithstanding these precautions, it is not inclined to bite, the best plan will be to smear a little blood upon the surface, drawn from the operator's finger, previously constricted with a tight fillet, or to wet it with a little sweetened milk. Immersion of the leech for a few minutes in small beer will sometimes induce it to take hold when hardly anything else will. When the number to be applied is considerable, they should be put in a tumbler, which is then inverted upon the part from which the blood is to be drawn, by which means they will be prevented from crawling about. It is a good plan, generally speaking, not to group them too closely together, but to let them fasten themselves at some little distance from each other. Another rule is not to pull them off, but to let them detach themselves, as they will be sure to do as soon as they have "taken their fill." Their forcible separation is not only a source of pain, but it sometimes leaves a portion of the jaw in the little triangular wound made by its bite, which is sure to become inflamed and irritable in consequence. As soon as they have all dropped off, the bleeding is encouraged by sponging the surface well with warm water, and then covering it with a thickly-folded flannel cloth, wrung out of hot water, and frequently renewed, for a period varying from thirty minutes to two hours, or even longer, according to the desired effect. The blood having ceased to flow, the part is sprinkled with a little powdered starch, and covered with a dry cloth. If there be any disposition to bleed more, or longer, than is deemed proper, the bites are covered with a piece of dry tinder, which, especially if a little pressure be conjoined with it, generally soon puts a stop to the effusion.

The number of leeches to be applied varies from a single one to several dozens, according to the intensity of the morbid action, and the age and strength of the patient. In the adult a good average number is from fifteen to twenty; in children, under five years of age, from three to six. In infants a single leech has sometimes been followed by fatal depression. The extraordinary delicacy of the skin, and, consequently, the great depth of the animal's bite, are reasons why leeching should be practised with more than common caution at this tender age.

There are certain localities where leeches should not be applied. Thus, in the first place, the face, neck, and other parts habitually exposed are, if possible, avoided, because the bites of these animals are liable to be followed by disfiguring scars, particularly objectionable in the female. Secondly, they must not be applied to the eyelids, scrotum, prepuce, labia and nymphæ, structures abounding in loose cellular tissue, and therefore readily admitting of great infiltration of blood, as well as extensive discoloration. Thirdly, they must not be placed along the course of a superficial artery or large vein, or over any of the nervous trunks; lest, in the first case, they should occasion serious hemorrhage, and, in the second, severe pain. Fourthly, care is taken to avoid the centre or focus of an inflamed surface, as they might seriously aggravate the morbid action, if not induce gangrene. Lastly, surgeons make it a rule not to apply these animals in the vicinity of specific ulcers, as chancres and buboes, for fear of inoculating their bites, and thus propagating the specific disease.

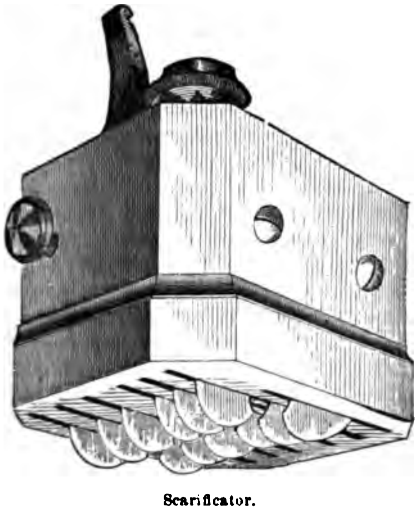
A discharge of blood by leeches for a number of successive hours is sometimes very desirable, as soon as one set drops off another supplying their place. In violent ophthalmia, croup, peritonitis, dysentery, erysipelas, and buboes, there is no mode of depletion so beneficial, or so well adapted to put a prompt and permanent stop to the disease, as this.

In leeching the uterus, vagina, ano-rectal outlet, the nose, and inside of the cheek, the animals must be confined in a glass or wire speculum, the opening in the instrument being held upon the part from which the blood is desired to be taken.

Serious, and indeed, frightful, hemorrhage sometimes follows a leech-bite. The occurrence is especially to be dreaded in children, in whom it occasionally produces fatal exhaustion. The best remedies are dried tinder, bound firmly upon the part, compresses wet with saturated alum water or a solution of the persulphate of iron, and cauterization with the solid nitrate of silver, cut to a delicate point, and inserted into the little wound, previously well cleansed and dried. If these means prove abortive, the edges of the wound are transfixed with a cambric needle, and approximated by ligature; a procedure which I have never known to fail.

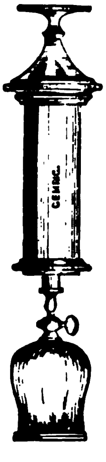
4. *Cupping.*—Cupping is by no means so eligible a mode of bleeding as leeching, being more painful, less elegant, and not so generally applicable. It is, nevertheless, when properly executed, a valuable operation, particularly in the early and declining stages of inflammation. An incipient pleurisy, pneumonia, or articular inflammation, is often promptly relieved by the application of half a dozen cups; but it is chiefly in the latter stages of acute disease, after the morbid action has been weakened by other remedies, and in chronic affections, that cupping asserts its true rank as an antiphlogistic agent. It is seldom, if ever, permissible in gastritis, peritonitis and enteritis, on account of the great pain produced by the application of the scarificator. The operation, to be really serviceable, should be performed as near to the seat of the disease as practicable, care being taken not to open any large vessel, to prick any nervous trunk, or to wound any tendons. The surface selected for the application of the cups must be free from bony prominences, and, without being very soft, must have a pretty good stratum of subcutaneous cellular substance, otherwise it will be impossible for the cups to maintain their hold, and extract a sufficient amount of blood. If the part be thickly covered with hair, it must be previously shaved.

Fig. 134.



Scarificator.

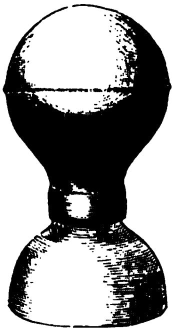
Fig. 135.



Cupping apparatus.

The scarificator, fig. 134, usually employed for dividing the skin, is provided with eight, twelve, or sixteen little blades, moved by a common spring, and so arranged as to make a corresponding number of incisions, none of them being deep enough to extend entirely through the cutaneous tissues, lest the fatty matter, projecting into them, should fill up the little orifices, thereby impeding the flow of blood. The cup is capable of holding from one to two ounces; it is bell-shaped, and is composed of glass, having a large mouth, with a stop-cock at the other end, to adapt it to a syringe for exhausting the air, as in fig. 135. When such an apparatus is not at hand, the ordinary cupping-glass may be used, or any still more simple contrivance, the air being rarefied by inverting the vessel over the flame of a lamp, or by means of a little pellet of cotton, wet with alcohol, and set on fire in the glass. In a few moments the skin will rise up and form a red conical swelling, which is now scarified, the cup being immediately replaced, and allowed to remain until the coagulum which fills its interior prevents the flow of blood, when it is carefully removed, to be again replaced as soon as the incisions have been freed from obstruction. Should the bleeding cease before the requisite supply has been obtained, the surface may now be cross cut, and the operation be proceeded with as previously. As much blood having been drawn as may be considered proper, the glasses are removed, and the parts are covered with a soft cloth moistened with oil. The number of cups to be applied varies from one to a dozen, according to the effect it is designed to produce.

Fig. 136.



Cupping-glass with vulcanized India-rubber top.

The most elegant and convenient cup, by far, is one recently invented in this country, consisting of the body of the ordinary glass cup, surmounted by a cone of vulcanized India-rubber, as seen in fig. 136. In order to apply it, all that is necessary is to indent the top with the finger, the removal of which permits the part instantly to regain its former position, thus exhausting the air within, which it does with great force and efficiency.

5. *Venesection.*—Venesection is commonly regarded as so trivial, simple, and easy an operation, that it has rarely received the consideration and attention to which its intrinsic importance really entitles it. Everybody, no matter whether he has any knowledge of the anatomy of the parts involved in the operation, or the slightest skill in the use of instruments, is supposed to be capable of performing it, and hence it is often done in the most bungling and disreputable manner, entailing much suffering, if not loss of limb and life, upon the patient, and great discredit, if not ruin, upon the practitioner. When we consider the frequency of the operation, and the character of the men who usually perform it, our only surprise is that these disasters are not more common. During a practice of upwards of a quarter of a century, in which I have often had occasion to open different veins, I have had the good fortune never to do any harm in this way, and it would afford me great pleasure if I could make a similar statement concerning the practice of some of my professional brethren. Candor, however, compels me to assert that I have repeatedly witnessed in their hands the most serious effects from this source. In two cases I have seen the patients perish from phlebitis; in three, I have been called upon to tie the brachial artery at the bend of the arm, on account of injury sustained from the lancet; in several, I have known vast and protracted suffering to succeed the puncture of a nerve; and in three instances I have seen the arm endangered by erysipelatous inflammation, followed by immense abscesses, and great impairment in the function of the elbow-joint, wrist, and fingers. In one of the cases here adverted to, the operator, a young man, was sued for mal-practice, and, after much trouble

and vexation, mulcted in the sum of several hundred dollars, which he was little able to pay. I need hardly add that he never recovered from the effects of his misfortune, which pursued him during the remainder of his life. It is related of Mons. Maréchal, who flourished in the reign of Louis XIV., and who was styled, by one of the poets of his day, the prince of surgeons, that he greatly suffered in his reputation, for several years, on account of a fatal accident which followed the operation of bleeding which he performed upon a foreign nobleman. These circumstances should be sufficient to put practitioners upon their guard, and should induce them to study this operation in all its bearings and relations, so that they may be able to perform it with credit to themselves and advantage to their patients.

A vein may be opened with a spring lancet, a thumb lancet, or a bistoury, according to the whim, fancy, or habit of the operator. I have been so long accustomed to the use of the former of these instruments that I rarely employ any other. My experience has taught me that the operation, when done with the spring lancet, generally answers every purpose, as it respects the size and shape of the orifice, the safety of the parts, and the facility of manipulation, while it is incomparably less painful than when it is performed with the thumb lancet, or bistoury. These are, I think, important desiderata, which no unprejudiced practitioner can overlook. No one who has himself been bled with these different instruments can hesitate about his future choice. I have often heard persons, who had been previously bled only with the thumb lancet, declare, after having been bled with the spring lancet, that nothing could ever induce them again to submit to the use of the former instrument, such was the difference in regard to the pain in the two operations. I know that the thumb lancet is generally considered as a more scientific instrument than the spring lancet; it is certainly more simple, and, perhaps, also more easily kept in order; but these advantages do not, in my judgment, outweigh the disadvantages. Both these instruments are so well known that any description of them here would be superfluous. If a bistoury be used, one of very small size should be selected, somewhat like that used in opening abscesses, described at page 147. It should be quite narrow in the blade, slightly pear-shaped at the extremity, and not more than half an inch long in the cutting part. Such an instrument, confined in a light handle, is more elegant than the ordinary thumb lancet, as well as more easily managed, and is, I think, decidedly more surgical and scientific; a circumstance so much insisted upon by some practitioners.

Whatever instrument be employed, care should be taken that it is perfectly sharp and clean, that is, free from rust and other adventitious matter. It should always be washed and thoroughly wiped both before and after the operation, for it is only by observing these precautions that the instrument can be kept in proper order, and that the surgeon can hope to avoid undue irritation and other mischief in the wounded structures.

In bleeding at the bend of the arm I am always in the habit of selecting the largest and most superficial vein, having previously ascertained that the brachial artery is not in danger of being wounded, as it may be when it lies just behind the vessel, or close along its side. When the artery separates high up, one of its branches generally lies immediately below the skin, and might thus be easily opened by an incautious operator. As it respects the superficial nerves, it is seldom possible altogether to avoid them, whatever vein may be selected; nor is this a matter of much moment, provided they are completely divided, and not merely pricked. The veins of the bend of the arm, with the accompanying nerves, are well seen in fig. 137.

In order to distend the veins, a fillet, a yard long by an inch in width, and consisting of a piece of muslin, is tied firmly round the arm, about two inches and a half above the bend, the ends being secured with a slip knot.

Care is taken not to draw it so tightly as to interrupt the circulation in the brachial artery. The patient, extending his arm at a right angle with the trunk, in a state midway between pronation and supination, grasps a common cane, a yardstick, or any other suitable object, holding the limb in an easy, gentle position. The surgeon then, standing behind the limb, pierces the vein, making the opening obliquely, and of sufficient size to furnish a free stream. The adjoining sketch affords a better idea of the manner of holding the lancet than the most elaborate description could. The surgeon uses whichever hand may be most convenient; the vein is thoroughly steadied with the finger previously to making the incision, and care is taken that the orifices in the skin and vessel do not afterwards lose their parallelism, lest the flow of blood should thereby be seriously embarrassed, or the fluid escape extensively into the subcutaneous cellular tissue. Should the latter accident occur, the fillet must immediately be removed, and the requisite abstraction effected from another vein. Sometimes the blood flows sluggishly, although the opening may be quite capacious and unobstructed. When this is the case, the patient should be requested alternately to flex and extend his fingers, so as to cause energetic contraction of the muscles of the forearm, which often powerfully promotes the bleeding; or, instead of this, or along with it, the operator applies friction to the limb from below upwards with his hand, although such a procedure is seldom attended with much advantage. Sometimes the flow of blood is interrupted by the protrusion of a pellet of fat into the orifice of the vein, or in consequence of the timidity of the patient, or the occurrence of partial syncope.

Fig. 137.

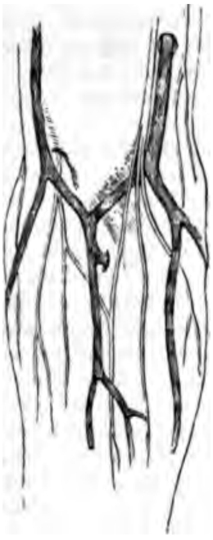
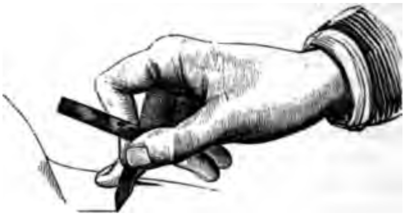


Fig. 138.



When the spring lancet is used, the instrument is held between the thumb and the first two fingers, the heel being raised a little from the surface, while the fleam is gently pressed upon the distended vein. The opening is effected in the same oblique manner as in bleeding with the thumb lancet.

The blood should always be received into a large basin held by an assistant, and special pains should be taken not to soil the patient's body or bedclothes. When the object is to make a strong and permanent impression, the blood is taken from a large orifice, the patient being, the while, in the semi-erect posture. If he is very plethoric, and the object is to abstract a very large quantity of blood, without occasioning syncope, the recumbent posture is selected. When the requisite amount of fluid has been discharged, the fillet is untied, and the arm is nicely wiped with a napkin wet at one end; the edges of the orifice are then carefully approximated and covered with a small, thick compress, supported by a narrow roller passed around the elbow in the form of the figure 8. The arm should then be put in a sling and kept at rest for the next forty-eight hours, as premature motion is calculated to favor the development of suppuration and erysipelas.

When blood cannot be obtained from the arm, it may sometimes, in case of urgency, be drawn from a vein on the back of the hand, from the cephalic vein as it runs along the groove between the deltoid and pectoral muscles, or from the external jugular vein. In the latter case, the requisite distension is produced by pressure with the thumb, applied just above the collar bone, or by means of a thick, narrow compress, firmly secured by a roller carried round the neck and shoulder. The requisite incision is made with a bistoury, carried from below upwards and outwards, in a direction contrary to that of the fibres of the platysma myoid muscle. Before removing the compression, care is taken to close the orifice of the vein, lest air should get into it, and thus occasion serious, if not fatal mischief.

The *accidents* which are liable to attend and follow this operation are, infiltration of blood into the subcutaneous cellular tissue, inflammation of the edges of the wound and of the surrounding parts, phlebitis, angeioleucitis, puncture of the nerves, and wound of the brachial artery.

a. An *extravasation* of blood beneath the skin is one of the most common effects of this operation, and may be caused by various circumstances, as the smallness of the incision, the want of parallelism between the outer and inner openings, the great laxity of the areolar tissue, transfixion of the vein, and the accidental occlusion of the wound by the interposition of adipose substance. The extravasation may be diffused, or circumscribed, forming in the one case an ecchymosis, in the other a thrombus. In the former variety, the blood sometimes extends along the anterior part of the limb, nearly as high up, on the one hand, as the axilla, and, on the other, as far down as the inferior third of the forearm; imparting, at first, a dark, purplish hue, and afterwards, as the fluid becomes absorbed, a mottled, greenish, yellowish, or sallow appearance to the skin. A thrombus is a collection of blood immediately around the wound, from the volume of a marble to that of a pullet's egg, irregularly rounded at the base, and usually somewhat pointed at the top. Both these accidents are most liable to occur in thin, emaciated subjects, in bleeding at the basilic vein, and they should always be promptly remedied by attention to the exciting cause; or, where this is impracticable, the bandage should immediately be removed, and the requisite quantity of blood taken from another vessel. The latter procedure is particularly indicated when the infiltration is dependent upon transfixion of the vein, the presence of a pellet of fat, or unusual laxity of the areolar tissue. Defective parallelism may sometimes be corrected by changing the position of the limb; and a small orifice may be enlarged by the re-introduction of the instrument. Under no circumstances, whatever may be the nature of the difficulty, should the operator attempt to promote the flow of blood by the use of the probe, inasmuch as this would inevitably be followed by mischief.

When the extravasation is slight, it will usually disappear spontaneously in a very few days; when considerable, recourse must be had to refrigerant and sorbefacient applications, particularly a strong solution of the hydrochlorate of ammonia, alcohol and water, and, in the latter stages, camphorated lotions, soap liniment, and stimulating unguents. If matter form, or if the parts become angry and inflamed, leeches, blisters, and cataplasms may be necessary, with incisions to evacuate the effused blood and other fluids.

b. The edges of the little wound, made in this operation, sometimes *inflame* and suppurate; or, instead of this, a small abscess, conical, circumscribed, and very painful, forms immediately around it. Occasionally, especially in feeble, sickly, and intemperate persons, the morbid action assumes an erysipelatous type. The most common causes of these mishaps are a dull, rusty, or foul lancet, imperfect apposition of the lips of the wound, improper tightness of the dressings, premature use of the parts, and, above all, the contact of the fingers, after the removal of the fillet, for the purpose of preventing the further escape of blood. The latter circumstance has not received sufficient attention. The fingers of the operator, without his being aware of the fact, are often covered with perspiration and other matter, which, when brought in contact with the edges of the incision, are almost certain to irritate and inflame them. My invariable practice is never to touch the wound for any purpose, but, after the fillet is removed, to approximate its lips with a clean compress, made of old muslin, and confined by an appropriate bandage. If, despite proper precautions, inflammation and suppuration arise, the usual antiphlogistic means must at once be employed.

c. Phlebitis, to a slight extent, is probably of much more frequent occurrence after this operation than is generally imagined, while the severer forms of the disease are comparatively rare. It may be induced by various circumstances, of which the employment of a foul lancet is perhaps the most common. In one instance I knew it to be caused by probing the wound, under the supposition that it contained a piece of the fleam of a spring lancet, broken off in the operation, which was performed by a young and inexperienced practitioner. The patient, a man, about thirty-six years of age, was laboring under bilious fever, from which, but for this unfortunate event, he would probably have recovered; phlebitis, however, set in, and he lost his life in less than a week. In another instance, more recently under my observation, the vein was opened with a thumb lancet, and the disastrous effect seemed to have arisen without any evident cause, the patient, a stout negress, having labored at the time under inflammation of the wrist joint. Death ensued in less than ten days after the operation. In some instances, if, indeed, not frequently, the inflammation takes place without any obvious cause, and that too, perhaps, when the operation has been performed in the most unexceptionable manner.

The symptoms of this form of phlebitis do not require special notice, inasmuch as they do not differ from those of phlebitis in general. The attack is commonly ushered in by pain, stiffness and swelling of the affected part, and by rigors, alternating with flushes of heat, and followed by copious perspiration. The inflamed vein is gradually converted into a hard, rigid cord, and the morbid action steadily pursues its course towards the heart, its progress being indicated by a reddish blush of the skin. In some instances, metastatic abscesses form in different parts of the body, particularly in the subcutaneous cellular tissue round the larger joints, if not also in the joints themselves. Meanwhile, the symptoms assume a typhoid character, the mind wanders, great soreness is felt in the muscles and articulations, the patient complains of excessive prostration, and death generally follows in from six to eight days from the commencement of the invasion.

The treatment consists in the application of leeches, blisters, and iodine along the course of the vein, and the exhibition of calomel and opium, with the twofold object of bringing the system promptly under the influence of mercury, and allaying pain and promoting sleep. Abstraction of blood from the arm is rarely indicated, and is, in general, prejudicial. Active purgation and the free use of antimony must also be avoided. If abscesses form, they must be thoroughly and promptly opened. Should recovery take place, sorbefacients will be required to promote the removal of effused fluids in and around the diseased vein, which, however, despite our treatment, usually remains impervious.

d. Angeioleucitis is usually produced by the same causes as phlebitis, which it also resembles in its nature, progress, and symptoms. The morbid action, still more than in the latter disease, has a tendency to extend up the limb, the course of the affected lymphatics being indicated by reddish lines, very narrow, and exquisitely tender on pressure. The malady, which is quite infrequent, and which rarely does much harm, requires the same treatment as phlebitis, with which it is occasionally associated.

e. Puncture of a *nerve*, whether a considerable-sized trunk, or a mere thread-like filament, may prove to be a very serious accident. The nature of the injury is always indicated by a peculiar stinging, burning, or pricking pain, and a sense of numbness, creeping, or formication in the distal portion of the limb. When very severe, the local distress may be attended with a certain degree of shock and a tendency to syncope, which, however, generally pass off in a very few minutes. Very unpleasant secondary symptoms sometimes succeed this accident, at a period varying from several weeks to several months. One of the most common and distressing of these is neuralgia, which is often attended with regular paroxysms, precisely as neuralgia is when it occurs from ordinary causes in other situations. The disease is then apt to be exceedingly severe and obstinate, often resisting for months, and even years, the best directed efforts at relief. In the cases which have fallen under my observation, it has usually been accompanied, especially in its earlier stages, with considerable swelling, numbness, and stiffness in the distal portion of the limb, together with exquisite tenderness on pressure along the course of the affected nerve. I have never known tetanus to follow this accident, but such an occurrence I should think quite possible, particularly in a person of a nervous, irritable temperament, laboring, at the time of the injury, under disorder of the digestive organs.

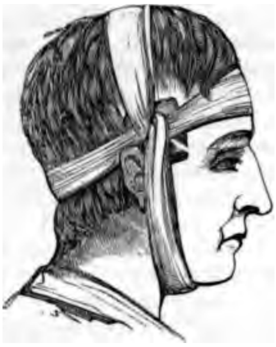
The milder effects of this injury will usually pass off in a very short time without any remedial measures, simply by attention to rest and elevation of the limb. This failing, recourse is had to anodyne and astringent fomentations, the application of iodine and even blisters, purgatives, light diet, and other antiphlogistic means. The bandage will often be of great service, especially when there is considerable swelling. If the pain is of a neuralgic character, quinine, strychnine, and arsenious acid will be indicated, and, if given persistently, and in suitable quantities, will be of immense benefit. Where the suffering is extremely violent and intractable, the best remedy is division of the affected nerve, as near as possible to the seat of the injury, by the subcutaneous method; or, where this is impracticable, by exposing the nerve first, and then severing it. Occasionally it becomes necessary to remove a small portion of the affected nerve, especially if, as now and then happens, it is expanded into a little nodule, or is exquisitely tender and sensitive on pressure.

f. A wound of the *brachial artery* is always a very serious accident, and is probably much more frequent than is generally supposed. The injury may be very slight, amounting to a mere puncture, or it may be several lines, half an inch, or even an inch in extent, as in a case under my observation, some years ago. The direction of the wound may be oblique, longitudinal, or transverse, according to the manner in which the instrument is held at the time of the operation. Occasionally the artery, instead of being pierced or stabbed, as it ordinarily is, is transfixed; a circumstance which always seriously complicates the case.

The immediate effect of this accident, which is always denoted by the impetuous, saltatory nature of the stream, and by its scarlet complexion, is to send the blood into the connecting cellular tissue, forming a soft, dark-colored, and circumscribed tumor, or a diffused swelling, which may involve the greater portion of the anterior surface of the limb from the middle of the forearm to within a short distance of the axilla. Such an occurrence is always formidable in its character, alarming to the patient, embarrassing to the surgeon, and liable to be followed by the worst consequences.

The treatment of this accident is by systematic compression, when the opening is small, and by ligation of each extremity of the artery, when it is large.

Fig. 139.



Compress applied to the temporal artery, after arteriotomy.

6. *Arteriotomy.*—This operation is occasionally necessary in urgent affections of the brain and eye, and is usually performed upon the anterior branch of the temporal artery, a vessel which possesses the twofold advantage of being very superficial, and at the same time resting upon a resisting bone. Feeling for the artery, in front of the temple, the surgeon applies firm pressure upon it with the finger, so as to steady it properly, while he makes the requisite incision with a small bistoury, carried obliquely across the vessel, care being taken to cut the parts in such a manner as to admit of a full and rapid stream. A sufficient amount of blood having flowed, the artery is completely divided, in order that its extremities may retract, and thus prevent the formation of an aneurism. A small thick compress is then placed upon the wound, and firmly secured by a bandage, carried round the head in the manner represented in fig. 139.

SEC. V.—TRANSFUSION OF BLOOD.

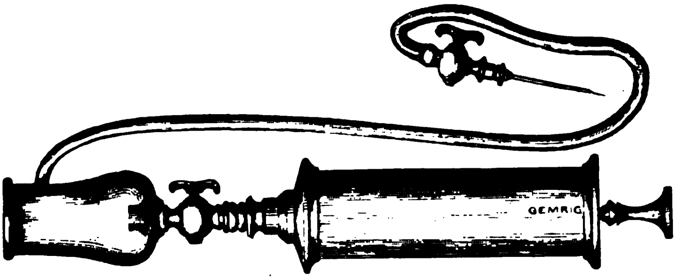
Transfusion of blood from the veins of one person to those of another is imperatively demanded when a patient is rapidly sinking from hemorrhage, whether the result of disease, accident, or operation. It has hitherto been more particularly employed in profuse and exhausting flooding, and there are about twenty cases upon record where it was thus instrumental in preserving life. In such an event it is the last resource of the obstetrician, and no one should hesitate to perform it, even although the woman should literally be in the act of dying, or when, to borrow the language of an eminent writer, "the vital spirit is fluttering with tremulous delay upon the lip." Instead of blood, saline fluid is sometimes transfused, as in attacks of Asiatic cholera, attended with excessive prostration, consequent upon the copious rice-watery discharges from the bowels effectually draining the vessels of their serous contents.

The operation in question requires great care and skill for its successful execution. The chief danger to be guarded against is the entrance of air into the vein, the smallest quantity of which might prove destructive. As ordinarily performed, it is necessary to have at hand, besides a lancet, a tumbler and a glass syringe, the latter being in complete working order. The person from whom the blood is taken must be in good health, and free from all constitutional taint. The arm being tied up, and the vein opened, the blood is allowed to fall into the tumbler as it stands in a basin of water, at a temperature of about 100°, lest the fluid should coagulate, and thus become unfit for use. As soon as about two ounces have been drawn, it is sucked up into the syringe, the nozzle of which is then inserted into the patient's vein, the median basilic, for example, previously exposed by an incision at least an inch in length, and raised upon a probe. In this manner one portion after another is cautiously thrown in until from twelve to sixteen ounces have been transfused, a quantity which it will seldom be judicious to exceed. Should the pulse flag during the operation, or convulsive tremors arise, the proceeding must immediately be suspended, as it is an evidence that injury instead of benefit is accruing.

A great number of contrivances have been devised for imparting to this operation a more scientific character than when it is performed with the ordinary syringe. The method, however, here described will generally be found to answer any purpose, combining, as it does, simplicity with convenience and safety.

When greater nicety is aimed at, the apparatus represented in fig. 140, and constructed, at my suggestion, by Mr. Gemrig, may be used. It consists, as will be perceived, of a small cupping glass and syringe, with a gum-elastic tube, about eighteen inches long, having a stop-cock at its distal extremity, which is surmounted with a nozzle cut off obliquely, like the barrel of a pen. The patient's vein having been exposed by an incision and freely opened, the nozzle is inserted into it and securely held by an assistant. A vein is then punctured in a healthy person's arm, but the blood is restrained from flowing by the pressure of the finger applied some distance below, until the cup has been placed over the orifice and exhausted of air by means of the syringe. As soon as this has been done, the stop-cock is turned, so as to permit the fluid to pass readily from one vessel into the other.

Fig. 140.



Author's transfusing apparatus.

SECT. VI.—VACCINATION.

The surgery of vaccination is very simple. It may be performed either with lymph, removed between the sixth and ninth day, or, what answers nearly equally well, with the dried scab rubbed upon a plate of glass, with tepid water, until it is of a thin consistence, and of a very pale milky hue. The matter is taken up with the point of a sharp, narrow lancet, a tenotomy knife, or a common needle, and inserted into the skin on the outer surface of the arm, just below the deltoid muscle, or on the outer and upper part of the leg at a suitable distance from the knee, at two spots, each about the diameter of a three cent piece, and sufficiently apart to prevent them from running together during the height of the resulting inflammation. The impregnation may be effected by a number of little punctures, by three or four superficial incisions, or, simply, by a slight abrasion of the epidermis. Whatever method be adopted, no blood should be drawn, as it might wash away the vaccine matter. When the operation is performed with lymph taken up on bits of ivory, a procedure which some practitioners prefer to any other, the points should be held for a few seconds in the steam of hot water, and then rubbed upon the raw surface.

The progress of a successful vaccination is as follows:—The wound, on the third day after the operation, is found to be slightly inflamed and elevated; and, on the fifth day, a characteristic vesicle appears, of a beautiful pearl-colored aspect, circular or oval in shape, and occupied by a drop of thin, limpid fluid. On the eighth day the vesicle is in its greatest perfection; it is now somewhat of a yellowish hue, distinctly cellulated in structure, very prominent, slightly umbilicated at the centre, and surrounded by a circular areola, the skin around being inflamed, tense, and painful. Occasionally considerable swelling of the glands of the axilla exists. The constitution is thoroughly implicated, and, as a consequence, the patient is feverish and restless. On the eleventh day, the areola begins to fade, and the vesicle, which usually spontaneously bursts, gradually dries up into a hard, brownish, circular scab, which, dropping off from the eighteenth to the twenty-first day, leaves behind it a small, rounded, pitted and indelible cicatrice, attesting the success of the operation.

Vaccination may be performed as early as the sixth week after birth, and at all periods of life subsequently. If the child is sickly, the general health should previously be amended, particularly so if there be any eruptive disease. Some persons evince the most remarkable insusceptibility to the influence of the vaccine poison. I have seen a number of cases in which the operation was performed upwards of twenty times before it finally succeeded. Healthy children afford the best lymph, and the matter of primary vaccinations is more energetic than that of secondary vaccinations.

The bad effects of the operation are, 1st, too much local action, the inflammation sometimes assuming a real erysipelatous character; 2dly, severe inflammation of the axillary glands; 3dly, ulceration, or even gangrene, at the seat of the vesicle, leaving a sore which is occasionally very tedious in healing; 4thly, a lichenous or roseolar eruption, attended with distressing itching, and often considerable swelling; and 5thly, an appearance of vesicles upon the general surface, resembling those of varicella, or even those of genuine cowpox. It is proper to add that the regular development of vaccinia is sometimes retarded by the pre-occupation of the system by other affections, as measles and scarlatina.

The effects of vaccination are sometimes completely lost, in the proportion, probably, of about forty persons in one thousand. It is for this reason that the operation should occasionally be repeated.

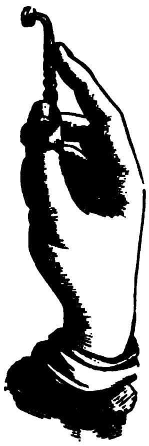
SECT. VII.—COUNTER-IRRITATION.

Counter-irritation may, as stated elsewhere, be established in various ways, as by rubefacients, vesicants, and dry cupping; but when the object is to make a deep and protracted impression, the means usually selected are the permanent blister, the seton, and issue. Sometimes the moxa and acupuncturation are employed.

1. *Rubefacients.*—A rubefacient effect, or temporary irritation of the skin, may readily be produced by a great variety of articles, as ammoniated liniments or unguents, spirits of turpentine, hot water, mustard, and the hot iron. The latter, in the form of the objective cautery, as the French term it, consists in passing a piece of iron, heated perfectly white, rapidly over the surface at a distance of from three to five inches. The skin becomes almost instantly red, and if the application be continued for a few minutes vesication will follow.

A very useful and speedy rubefacient action may also be produced by means of Dr. Corrigan's button cautery, fig. 141, heated in the flame of a brass spirit lamp until the forefinger, resting upon the shank of the instrument near the disk, begins to feel uncomfortably hot, the period usually required not exceeding a quarter of a minute. As soon as it is ready, it is applied as quickly as possible, the skin being tipped successively, at intervals of half an inch, over the whole of the affected part, which soon assumes a bright red appearance, and becomes the seat of a glowing sensation. The disk of the instrument is half an inch in diameter by three lines in thickness, with a flat surface, and a thick iron wire shank, two inches in length, and inserted in a small wooden handle.

Fig. 141.



Corrigan's button cautery.

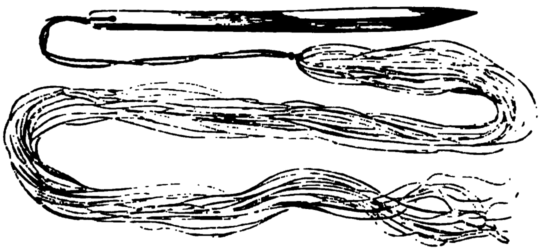
2. *Dry Cupping.*—Dry cupping is occasionally employed, especially in chronic affections, in which it is often of great value. The air being exhausted, as in the more common operation, the cup is allowed to remain on the part for a period varying from thirty to forty-five minutes. At the end of this time it will generally be found that there is not only a marked afflux of blood, but likewise more or less vesication of the skin, objects which the practitioner should always endeavor to attain whenever he advises such an operation; for, unless it be performed efficiently, it might as well not be performed at all.

Dry cupping is particularly serviceable in chronic disease of the brain and spinal cord, the thoracic and abdominal viscera, and the larger joints. The number of cups employed, and the repetition of the operation, must of course be regulated by the exigencies of the particular cases.

3. *Permanent Blisters.*—A permanent blister is made by letting the fly remain on the skin an unusual length of time, and then divesting the part of epidermis. It is capable of furnishing a free discharge of pus, which may often be maintained for a long time, either by the occasional re-application of the fly, or by means of some irritating ointment, as the savin or mezereon, or, what I prefer, an ointment composed of an ounce of lard and three to eight drops of nitric acid. Whatever article be used, the surface should be constantly protected with an emollient poultice or the warm water-dressing, otherwise the sore will become excessively irritable, and cease to furnish the desired discharge. Whenever the secretion begins to slacken, a little of any of the unguents here mentioned may be applied to the sore to renew the morbid action. I have occasionally used the dilute fly ointment for this purpose, but having several times produced strangury with it, I have latterly abandoned it.

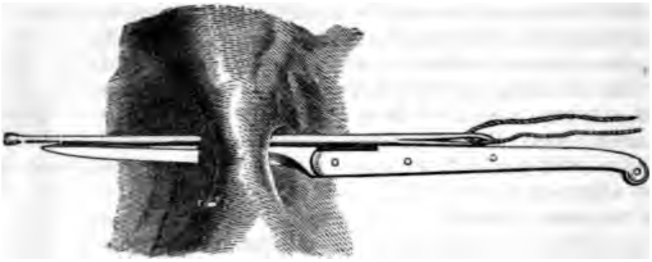
4. *Seton.*—A seton is a subcutaneous wound, holding a foreign body. It may be made with a bistoury, and a piece of gum-elastic tape, or, in the absence of this, a narrow strip of muslin, conveyed beneath the skin by means of an eyed probe or the seton needle, represented in fig. 142. The integuments being pinched up, the instrument is pushed on through the cellular tissue, care being taken not to interfere with any muscular fibres, tendon, nerve, or vessel. The ends of the seton are tied long, and held out of the

Fig. 142.



way by a strip of adhesive plaster. The mode of introducing a seton with the knife and probe is shown in fig. 143.

Fig. 143.



An emollient cataplasm is the most suitable dressing, both immediately after the operation and subsequently, during the sojourn of the foreign body. At the end of the second day, the tape is drawn gently across the wound, a fresh portion taking its place, and this process is afterwards repeated as often as cleanliness and other circumstances may render it necessary. If the discharge becomes deficient, recourse is had to some stimulating ointment; if offensive, to the chlorides. When the tape becomes soiled and unfit for use, it is replaced by a new one. Sometimes fungous granulations spring up at the orifices of the subcutaneous wound, causing much pain and inconvenience. The best remedy is excision, followed by the nitrate of silver. The insertion of a seton is usually attended with little bleeding; but I recollect the case of an elderly gentleman, a patient of a late eminent practitioner, who nearly lost his life from this cause, the operation having been performed upon the nape of the neck. The blood seemed to have proceeded from a small artery among the cervical muscles, the instrument having penetrated too deeply.

A seton is, on the whole, a filthy, painful, and imperfect form of counter-irritation, which it might, perhaps, be well to exclude altogether from practice, as its place may always be easily supplied by the issue.

5. *Issue.*—An issue is an artificial ulcer, intended to furnish a discharge of pus. It is adapted to the same class of cases as the seton, but is more cleanly, less painful, and more convenient. Moreover, such a sore affords a good surface for the local application of morphia and other remedies, which may often be advantageously used, in this way, for relieving pain, as well as for other purposes.

Issues may be made in various ways, as with the knife, the Vienna paste, and the actual cautery. The first of these methods is not sufficiently efficient to justify its general employment; it is better adapted to the scalp than to any other region of the body, and may be advantageously used in diseases of the pericranium, and of the brain and its meninges. An incision being made through the skin and cellular tissue, from half an inch to an inch in length, its cavity is filled with some foreign body, as a pea, grain of corn, small pebble, or piece of orris root, which soon produces a pyogenic action, that may afterwards be increased, if necessary, by the use of some stimulating ointment, in the same manner as in the case of the seton. The substance is confined with a strip of adhesive plaster and a bandage, and is occasionally replaced by a fresh one, cleanliness being maintained in the usual way.

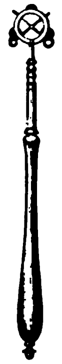
A better plan is to make the issue with the *Vienna paste*, composed of equal parts of quicklime and caustic potassa, thoroughly triturated together, and preserved in a closely corked vial until required for use. The requisite quantity is then put upon a piece of glass, or upon the bottom of a saucer, and converted into a thick paste with alcohol. A layer about two lines in thickness, and of the desired diameter, is put on the skin, and allowed to remain for eight, ten, or fifteen minutes, according as we wish to make a slight or deep impression. The surface, which will be found to be of a pale drab color, is washed with vinegar and water, to neutralize the alkali, and covered with an emollient cataplasm, to promote the detachment of the slough, which usually happens in from five to eight days. Some pain attends the operation, but this is soon over, and bears no comparison with the horrible distress produced by the application of caustic potassa alone; besides, the Vienna paste does not diffuse itself over the adjacent parts, and thus unnecessarily destroy the skin. The extent of the issue is regulated by the extent of the layer; one of the diameter of a twenty-five cent piece affording, when the sloughing is completed, a sore from three to five times that size. The best permanent dressing is a poultice; the best promoter of discharge, a stimulating ointment, or the occasional use, for a few hours, of a small blister.

The most eligible issue of all, however, is that made with the *actual cautery;* it affords not only an abundant and protracted discharge, far beyond what follows the more ordinary issue, but, what is often a matter of no little consequence, it makes an impression both upon the part and system, which no other mode of counter-irritation is capable of producing. On these accounts, this kind of issue should have a decided preference over every other in all protracted and obstinate cases of disease where the employment of revulsives is indicated, as in caries of the hip-joint, Pott's disease of the spine, and similar affections, in which its powers, as a topical remedy, are unequalled.

The actual cautery, when used for this purpose, is of course attended with pain, and for this reason it will generally be well to administer some anæsthetic, although the suffering is much less than is usually imagined. Formerly, before the discovery of this class of agents, I was constantly in the habit of making this kind of issue, and often had occasion to notice the little pain it produced, even in very young children and nervous persons. The manner of proceeding is to heat the cautery perfectly white in a chafing-dish of charcoal, and then to hold it, with some degree of firmness, upon the proper spot, until the skin is converted into a dark eschar, care being taken not to penetrate beyond the subcutaneous cellular substance. A cloth, wrung out of cold water, is immediately laid upon the part, and frequently renewed, for ten or twelve hours, when it is replaced by a poultice or the warm water-dressing. The slough usually drops off in from five to ten days, leaving a sore, which, while it is easily kept clean, furnishes a free discharge, and may be maintained open, with but little care, for an almost indefinite period. A cautery the size of a half eagle will make an issue, after the separation of the eschar, of the diameter of a silver dollar. The instrument should be fully half an inch thick, otherwise it will not retain its heat sufficiently long.

6. *Moxa.*—The moxa is a soft combustible substance held upon the skin, and suffered to burn down slowly, so as to produce a temporary irritant effect. It may be prepared from various articles, as agaric, hemp, cotton, rotten wood, the pith of the common sunflower, and the down of the artemisia chinensis; but the one which I usually prefer is soft patent lint, soaked in a strong solution of nitrate of potassa. When thoroughly dried, this is rolled up into tolerably firm cylindrical cones, an inch and a half long by one inch in diameter. In applying them they should be ignited at the top, and held upon the part intended to be cauterized with a pair of dressing-forceps, a long hair-pin, or a porte-moxa, fig. 144; care being taken to protect the surrounding surface with a piece of wet linen perforated at its centre. When it is desired to hasten the combustion a blowpipe may be employed, but in general this is unnecessary. Whatever substance be used, the

Fig. 144.



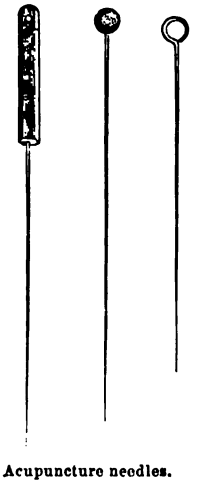
Porte-moxa.

heat can be so graduated as to produce any amount of irritation, from the slightest rubefaction to a superficial eschar. When the latter effect is desired, the moxa should remain on until it is wholly consumed; otherwise it may be removed as soon as the pain becomes somewhat severe, or, instead of placing the burning material in contact with the skin, it may be held at a little distance from it. The eschar is of a yellowish, gray, or dark color, and usually drops off in six or eight days. The pain produced by the operation may be promptly relieved by the application of liquid ammonia, cold water, or pounded ice.

The moxa seems to act on the same principle as the objective cauterization, and the ammoniated counter-irritants, already spoken of, and is a valuable agent in many chronic cases, when it is intended to produce a sudden impression upon the nerves of the affected part: it should always be applied as near as possible to the seat of the malady, and the effect should be sustained for weeks, or even months, by the repeated application of the agent. The diseases in which it seems to be most efficacious are amaurosis, neuralgia, nervous deafness, partial paralysis, coxalgia, and spinal irritation.

7. *Acupuncturation.*—Counter-irritation may be effected also by acupuncturation. This consists in the insertion of very slender, well polished, sharp-pointed steel needles, figs. 145, 146, 147, from two to four inches in length, furnished with a metallic head, or a head of sealing wax. To prevent them from breaking, they should be rather soft and flexible. They are introduced into the affected part, which is previously stretched, by a gentle rotatory motion, aided by slight pressure, and are suffered to remain from one to six hours, according to the effect they produce, or the object they are intended to fulfil. In some instances a period of ten minutes is sufficient; in others, they may be kept in for one or two days. They may be carried to a depth of several inches, but care must be taken not to transfix any important viscera, vessels or nerves, though this has been often done without ceremony, and without any injurious results. The number of needles to be used varies from one to a dozen, according to the extent of the affected part and the sensibility of the patient. The operation rarely causes much pain, and is scarcely ever followed by any unpleasant symptoms. In most cases a slight blush, which subsides in a few hours, is observed around each puncture. In withdrawing the needles, which is sometimes effected with difficulty, owing to their having become oxidized, a movement of rotation should be given to them, at the same time that pressure is made upon the adjacent surface with the thumb and forefinger.

Figs. 145, 146, 147.



Acupuncture needles.

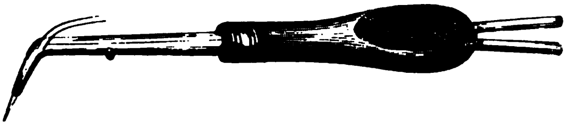
Acupuncturation has been employed in a great variety of affections, as neuralgia, rheumatism, gout, sciatica, paralysis, cephalalgia, and epilepsy; recently it has been recommended in the treatment of aneurism, hydrocele, varicocele, and anasarca. Its advantages have been much overrated, and the practice, which has been borrowed from the Chinese and Japanese, has fallen into disrepute.

8. *Electro-puncturation.*—Needles are sometimes introduced into the tissues for the purpose of transmitting to the affected part a current of electricity or galvanism. The operation, denominated, in the one case, electro-puncturation, and, in the other, galvano-puncturation, is performed in the same manner and with the same instruments as in the ordinary process, except that the latter have a small ring at the top for receiving the conducting wires of the

poles of the battery. Only two needles are used at first, but the number is gradually increased as the patient becomes able to endure the action of the current. When it is intended to produce a shock, a Leyden jar may be employed, but for maintaining a steady effect a small horizontal galvanic pile is the most appropriate apparatus. This mode of counter-irritation is almost entirely restricted to the treatment of chronic affections, attended with deep-seated and inveterate pains, as gout, rheumatism, neuralgia, and sciatica.

9. *Galvano-cauterization.*—A very ingenious and useful instrument for applying heat by means of galvanism was invented in 1850, by Mr. Marshall, of London, and is depicted in the annexed sketch, fig. 148. It is called the *galvanic cautery*, and is particularly serviceable as a stimulant in the treatment of old rebellious sinuses and fistules. The apparatus consists of a pair of forceps with projecting iron handles, and long, narrow blades, terminating at an acute curve, and arranged so as to hold a platinum wire. The diseased passages being well cleaned and dried, the wire is introduced cold, and then heated by the galvanic current red hot or otherwise, according to the wished-for effect. When it is designed to destroy the tissues, as in the operation for anal fistule, the wire must be drawn to and fro with a sawing movement to facilitate their division. The battery should have from six to nine cells, filled with a mixture of one part of sulphuric acid to ten of water. The rods are isolated by an intermediate strip of ivory.

Fig. 148.



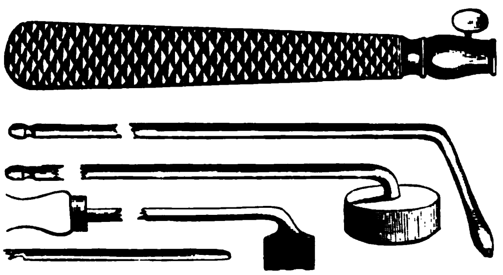
Marshall's galvanic cautery.

SECT. VIII.—ESCHAROTICS.

There is a class of operations which consist in destroying the affected tissues with caustics, consisting of the hot iron and of various escharotic substances. These procedures, however, once so much in vogue among surgeons, have become almost obsolete, although they are perhaps still too much practised in certain quarters, especially in France. At the present day they are restricted, in great measure, to affections of the neck and orifice of the uterus, and of the mammary gland, hemorrhoidal tumors, varicose veins of the extremities, specific ulcers, as chancres and malignant pustules, and the bites of snakes and rabid animals.

When the hot iron is used for the purposes in question, it should be heated to a white heat, and retained in contact with the diseased parts sufficiently long to effect their destruction, their surface being previously thoroughly dried. In performing the operation, the surrounding structures should be carefully protected from injury, and in order to obtain the desired result it is frequently necessary to have two, three, or even four cauteries in readiness, so that, as one becomes cold, another may take its place. The eschar generally drops off at a period varying from four to ten days. The best apparatus for heating the iron is a little furnace, charged with charcoal, the combustion being promoted with a pair of bellows. The annexe fig. 149, conveys a good idea of the principal forms of iron in use at the present day. The conical-shaped instrument is well adapted for cauterizing narrow and deep-seated cavities; the cylindrical one may also be used for this and similar purposes. The hatchet-shaped iron is well adapted for making a linear eschar, and the large round one for establishing a deep, permanent issue.

Fig. 149.



Different forms of cauteries.

Caustic potassa, the Vienna paste, chloride of zinc, bichloride of mercury, arsenic, ammonia, and certain acids, as the nitric, hydrochloric, and sulphuric, are powerful caustics, producing their peculiar effects more or less promptly, according to the length of time during which they are retained, and the strength in which they are used. As their application is generally attended with severe pain, it is proper that the patient be previously put under the full influence of an anæsthetic. Moreover, as some of the articles here specified have a tendency to diffuse themselves over the surrounding healthy surface, care should be taken to prevent this by placing a wall of simple cerate or collodion around the part to be cauterized.

Caustic potassa is a powerful escharotic, but as it is extremely painful and very tardy in its action, it is now seldom employed. The Vienna paste, composed, as already stated, of equal parts of quicklime and caustic potassa, although also productive of severe suffering, does its work much more rapidly —generally in from ten to fifteen minutes—and is therefore usually preferred. The *chloride of zinc* is usually mixed with farina, forming thus what is called the phagedenic paste of Canquoin, of which there are three strengths, known as number one, two, and three; the first consisting of one drachm of the metal to double that quantity of farina, the proportions of the second being as one to three, and of the third as one to four, the latter being of course much the weaker. The preparations act with great efficiency, but are productive of excessive pain.

Bichloride of mercury, in the proportion of three parts to one of powdered opium, with the addition of a sufficient quantity of sulphuric acid to convert it into a paste of the consistence of tar, makes a powerful escharotic; but, owing to the excessive pain which it causes, and the risk of its inducing salivation, it is now rarely used. A similar objection is applicable to the caustic mixture, formed of equal parts of white arsenic and sulphur, formerly so much in vogue. A decisive escharotic effect may speedily be produced by the use of equal parts of ammonia and lard.

A very destructive escharotic, admirably adapted for the removal of epithelial growths, may be prepared with fifteen grains of white *arsenic*, seventy-five of cinnabar, and thirty-five of burnt sponge, made into a thick paste with a few drops of water. This constitutes what is called Manec's paste, and is applied in the form of a thin layer to the surface of the affected part, previously well cleansed in order to promote its effects. The great objection to this remedy is the excessive pain it produces and its liability to cause vomiting, depending, doubtless, upon the absorption of some of the arsenic. Generally also its application is followed by deep discoloration and severe swelling. For these various reasons it should be employed with great caution.

The stronger *acids*, as the nitric, hydrochloric, and sulphuric, produce an instantaneous escharotic effect when applied to a denuded surface; hence they are often used for cauterizing inoculated wounds and destroying the edges of ulcers. Of all the acid preparations, however, the best and most reliable is the *acid nitrate of mercury*, of which frequent mention will be made hereafter. The formula which I employ is that usually known in this country as Bennett's. It is prepared by dissolving, with the aid of heat, 100 parts of mercury in 200 parts of nitric acid, and evaporating the solution to 225 parts. The application produces a white eschar, which is detached, piecemeal, in from the third to the tenth day. Whatever article be employed, the utmost care must be taken to prevent its diffusion over the surrounding healthy tissues, otherwise the effects may be most unfortunate. *Chromic acid* also deserves favorable mention; its application, which causes but little pain, is particularly valuable in cases of warty excrescences and of recent chancres.

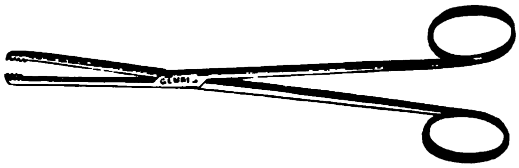
SECT. IX.—DRESSING.

The art of dressing, humble though it be, must not be despised by the surgeon; since, in many situations, both in private and hospital practice, it must necessarily form a part of his daily routine duties. There is, indeed, great reason to believe that this matter is too much neglected by practitioners, and that it is too frequently delegated to ignorant, careless, and unscrupulous nurses, and to the so-called dressers, who are often not a whit more enlightened, or more conscientious.

The most important appliances used in dressing are forceps, scissors, and syringes, sponges, lint, pledgets, tents, adhesive plaster, bandages, cataplasms, and unguents.

The *dressing forceps*, fig. 150, differ from the ordinary dissecting forceps in having ring handles, and cross blades, terminating each in a rounded, spoon-shaped extremity, supplied internally with serrated edges, to adapt it the better for seizing and holding such substances as may require removal. They are light and slender, and from four and a half to five inches in length. When not at hand, the ordinary dissecting forceps may advantageously be used as a substitute.

Fig. 150.



Dressing forceps.

The best *scissors*, for dressing purposes, are the ordinary straight pocket case instrument, which may be used either for cutting adhesive strips and bandages, or, if necessary, for paring the edges of ulcers, or for removing redundant granulations. Scissors curved on the edge or flat are sometimes very convenient.

The *sponges* used in dressing should be very soft and clean, and the same articles should never be employed upon different persons, especially when they are affected with open ulcers, as the discharges might thus be made the vehicle of propagating disease, as, for instance, in chancre, gonorrhœa, erysipelas, malignant pustule, and hospital gangrene. In all such cases they should be destroyed as soon as the dressing is completed, or thoroughly washed in water, and then soaked in a solution of chlorinated soda.

As a general rule, no sore should be wiped; but the water should be pressed upon it from a sponge held some distance from its surface, which will generally effectually wash away any secretions that may be in contact with it. Adherent lymph, charpie, or unguent may be picked away with the forceps. The surface around, however, may be gently sponged, if soiled; otherwise it may be wiped with a soft dry cloth. The water may be tepid, cool, or cold, according to circumstances, and arrangements should always be made to receive it into a suitable basin, placed beneath the affected parts. The old dressings should be put into a separate vessel, and promptly removed from the patient's apartment. Fetor is allayed by the free use of the chlorides, sprinkled both upon the body and bedclothes, as well as about the room.

Lint is a soft, fleecy substance, consisting either of prepared cotton, or scraped linen, or, what is preferable, the ravellings of linen, as those of an old napkin, sheet, or pillow-case, each thread being picked out separately. The article generally employed in this country is patent lint, which is kept in rolls in the shops, and makes an excellent dressing, although not equal to linen ravellings, or the charpie of the French surgeons; one surface is glazed, the other smooth. The objection to it is that it is not sufficiently porous to admit of the free escape of the secretions of the parts to which it is applied, and, consequently, also, that it keeps them too warm.

A very excellent, cheap, and convenient article for dressing wounds and ulcers may be prepared by folding a piece of old muslin until it forms a body from a quarter of an inch to half an inch in thickness, and then punching numerous holes into it, giving it thus a sievelike appearance. It is very light and airy, and while it absorbs moisture, it also admits of ready drainage. It forms a good substitute for patent lint, and may be used in cases where the other is not applicable. It may be called the *perforated muslin.* Dr. Levis, who has thoroughly tested its efficacy in the surgical wards of the Philadelphia Hospital, speaks of it in high terms of commendation.

Spongio-piline is now much employed as a dressing. It is a soft, porous fabric, looking very much like a piece of sponge; it is made in sheets from half an inch to an inch in thickness, and being covered with a glazing of India rubber, is well calculated to retain water and prevent evaporation, at the same time that its weight is not so great as to cause oppression.

Sometimes the lint is arranged in the form of a *compress*, pledget, ball, roll, tampon, tent, or pellet, thus adapting it the more conveniently to particular purposes. Thus, a compress consisting of a strip of folded muslin or linen may be employed for pressing together the sides of a deep abscess, or a number of pieces may be piled upon each other, so as to form a graduated compress, which is often advantageously used for compressing a bleeding vessel, as the brachial artery where it runs along the inner edge of the flexor muscle. The *pledget* is a strip of patent lint, usually spread with cerate, for protecting the surface of a granulating ulcer; balls, rolls, and tampons are simply masses of soft substance, as charpie, lint, or cotton, arranged so as to adapt them to particular cavities, as the uterus, the nose, or a deep wound, either with a view of arresting hemorrhage, or for absorbing pus and other fluids. The *tent* consists of a piece of linen, muslin, or patent lint, twisted on its axis, slender, and usually several inches in length, its object being to prevent the reunion of the sides of the incisions made in puncturing abscesses, and in laying open sinuses, as in the operation for anal fistule. Tents are sometimes prepared with wax, in which case they are generally of a conical shape, and employed as dilators. Finally, the *pellet* is a ball, roll, or mass, of soft tissue, inclosed in a strip of soft cloth, firmly tied; it may be used for the same purposes as the tampon, of which, in fact, it is merely a variety. When intended for the nose, uterus, or rectum, a stout thread or piece of twine may be tied to it in order to facilitate its removal.

Within the last two years a good deal has been written respecting the use of *drainage-tubes*, a means of treatment suggested by Mons. Chassaignac, for favoring the discharge of matter from abscesses and sinuses, especially when large and deep-seated. These tubes, which are from one to two lines in diameter, and perforated by numerous oval foramina, are made of India rubber, and are, consequently, highly elastic and flexible; their shape is cylindrical, and their length varies, on an average, from three to six inches, according to the exigencies of each particular case. The great objection tó these tubes is their liability to become clogged, and their tendency to cause undue irritation in the parts into which they are introduced. For these reasons it is questionable whether they will ever come into general use.

Poultices form an important element in a great variety of dressings, but as these have already received sufficient attention, it would be out of place to say anything further respecting them here. I shall only add that, when they are selected for this purpose, they should be used with special reference to the comfort of the parts, care being taken that they do not oppress by their weight, or irritate by their long retention and the stimulating character of their ingredients. The mode of employing water-dressings has also been sufficiently considered in another part of the work to render any further remarks regarding them here unnecessary.

Unguents, ointments, or salves of various kinds are employed as dressings in ulcers and other open surfaces; much has been said and written upon the subject, especially of late years, and attempts have been made to discard these substances altogether from practice. Still, notwithstanding all this, unguents hold a prominent place in the affection of many practitioners, as well as in that of the common people, and it would be difficult, I am sure, always to dispense with their use. I imagine that prejudice has had much to do in proscribing this class of remedies; when such a man as Liston raises his voice against any point of practice, it is usually very hard for the lesser lights of surgery to resist its influence, and the cry therefore at once becomes general, whether there be any just reason for it or not. It cannot be denied that rancid ointments act as irritants; this, however, is not the fault of the article, but simply of him who uses it. Prepared and employed for the occasion, experience teaches me that the application of unguents is often attended with the most salutary effects, admirably protecting granulating surfaces, and rapidly promoting cicatrization. As a general rule, I have found that all the officinal medicated ointments are much too strong, requiring to be diluted from one-half to seven-eighths.

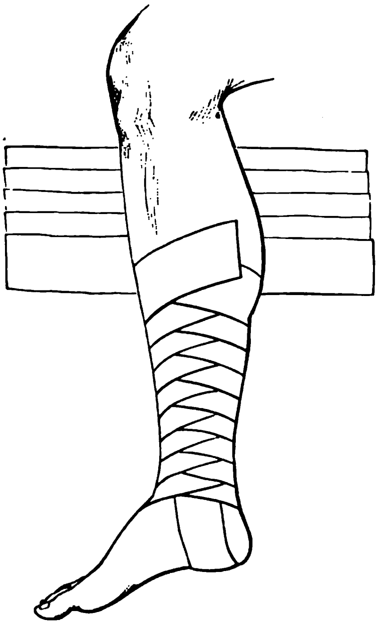
Whatever dressings be employed, they should be carefully confined by means of a bandage, evenly and lightly applied, so as to afford the requisite support, and no more. In most situations, this may be readily done with the common roller; but in certain regions, as in the groin, perineum, anus, and head, particular contrivances may be necessary, as the spica, the T bandage, and the four-tailed bandage. For retaining dressings upon the testicle and mammary gland the suspensory bandage will be found most convenient.

SECT. X.—BANDAGING.

Bandages are substances employed for retaining dressings in cases of wounds, ulcers, abscesses, fractures, dislocations, and other affections, as well as with a view to their direct curative effects, which, as will be shown by and by, are probably much greater than they are generally supposed to be. They vary much in shape and size, and also in regard to the materials of which they are composed, and the object which they are designed to fulfil. A vast number of bandages have been described in certain modern works, especially those on minor surgery, much ingenuity, and, according to my belief, much time, having been wasted, in trying to adapt them to every part and region of the body, and to every circumstance, however insignificant, to which such contrivances can possibly be applied. By running into these extremes, the art of bandaging has been greatly complicated, and much injury inflicted upon a department of surgery, which, if properly administered, is capable of conferring immense benefit in almost every form of accident and disease affecting the external parts of the body. The ancient surgeons racked their brains to invent names for designating bandages, and the claims of not a few of them to distinction were based almost exclusively upon such absurd and puerile pursuits. If a man was so fortunate as to devise an apparatus for expelling peccant humors, for retaining a cataplasm upon the scalp, or for supporting a diseased breast, the height of his ambition was generally amply gratified. It is to be feared that these employments have had too many imitators in modern times.

The more simple a bandage is the more likely will it be, if judiciously used, to answer the purpose for which it is intended; all complicated contrivances of this kind are objectionable on account of the difficulty of applying them, the ease with which they become deranged, and the trouble and vexation of changing them, the attempts to do so being frequently attended with serious inconvenience and pain to the patient, and perhaps great detriment to the parts affected. In general, the single-headed roller is all that can be required in almost any case; occasionally the strip-bandage, commonly known as the bandage of Scultetus, represented in fig. 151, may advantageously be employed, especially in compound fractures and dislocations. The many-tailed bandage ought, on the contrary, to be discarded from practice, as inconvenient and useless. It consists, as the name indicates, of a number of transverse slips, of the same width but unequal length, stitched to a longitudinal portion, and was formerly much employed in cases of fracture of the leg.

Fig. 151.



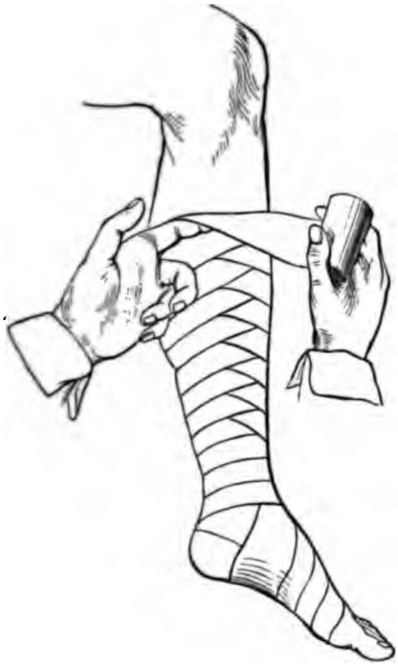
Bandage of Scultetus.

Bandages are composed of various materials; generally of muslin, bleached or unbleached, of calico, or of linen, the only objection to the latter being its expense. Occasionally they are made of flannel, especially when it is desirable to protect the parts from cold, as in œdema of the extremities, and in the swelling attendant upon a gouty or rheumatic state of a joint, in persons of an unhealthy, broken constitution, who are commonly so extremely susceptible of atmospheric vicissitudes. In general, muslin will be found to answer every purpose, being both cheap and easily procured; it should be soft yet firm, smooth, strong, and not too yielding, divested of selvage and seam, and washed before it is applied. Calico is not a good material for bandages, as it is usually too light and flimsy; I never employ it. In some cases, particularly in affections of the veins of the leg requiring steady and equable compression, gum-elastic cloth may advantageously be used.

The length and width of a bandage are of course subject to much diversity, depending upon the shape and size of the part to which it is intended to be applied. Hence, while in one case it need hardly be half an inch in width, and not more than a foot in length, in another it may require a width of two, three, or even six inches, as in injuries of the chest, and a length of many yards. Muslin is usually torn into the requisite sized strip, whereas linen, being much stronger, is best shaped with the scissors. The ravellings being picked away, each piece is rolled into a firm cylinder, and put away for use, so that it may be ready for any emergency that may arise. The winding may be effected either by hand, the cloth being held upon the front of the thigh, or by appropriate machinery, such as is to be found in the office of every practitioner, and of which illustrations may be seen in most of the works on minor surgery. However effected, it should be done with great care, since no one can possibly apply a bandage well that has been wound in a loose and slovenly manner.

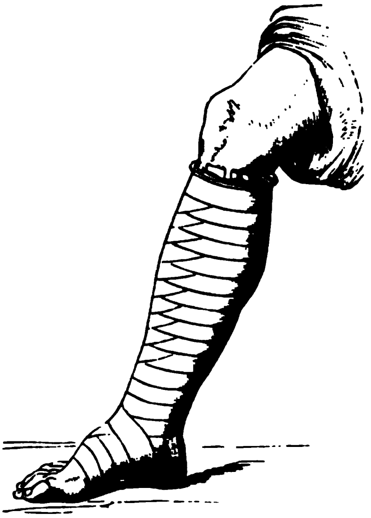
When intended to be used upon an extremity, the rule is always to begin at the distal portion of the limb, and to proceed from thence upwards some distance beyond the seat of the disease or injury. The end of the bandage being slightly unfolded is held firmly upon the part with one hand, while the cylinder is carried round the limb with the other, and thus the application is continued by circular and reversed turns, as they are named, until the object has been completed, the fingers being pressed upon each reverse to flatten and equalize it, as in fig. 152. If the bandage were put on spirally, it could not

Fig. 152.



Mode of applying the roller by circular and reversed turns.

Fig. 153.

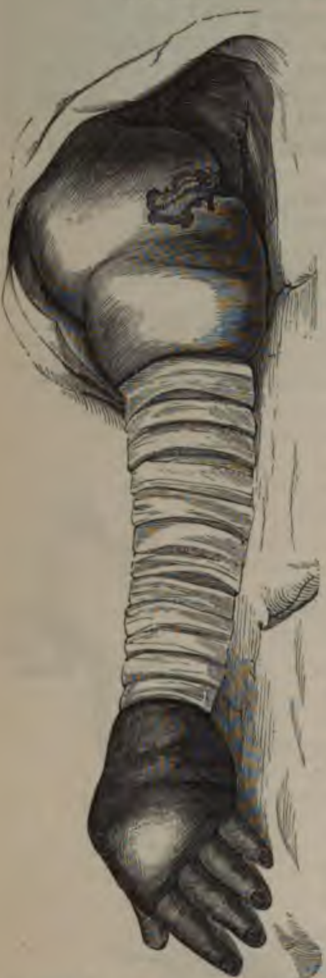


Appearance of the bandage after it has been applied.

maintain itself upon the limb for any length of time; but what is worse, the compression would be so unequal as to cause severe suffering, and perhaps even mortification. The application, then, must be made circularly, and care taken that each turn of the roller be reversed, so that the inner surface shall be the outer, and the upper edge the lower, the pressure being uniform throughout, or not greater at one point than at another, as in fig. 153.

The evil effects of unequal compression by the bandage are well illustrated in fig. 154, copied from John Bell's works; it also shows how important it is always to begin the application of the bandage at the distal extremity of a limb, and not above the wrist or ankle, as happened in the case so graphically described by the celebrated Scotch surgeon. In all cases of severe injury or disease, with a tendency to swelling and to the extension of the morbid action, due allowance must be made for the inflammatory effusions that will necessarily occur. Hence, too much care cannot be taken both in applying the bandage and in watching its effects afterwards. For want of this precaution many a limb has been destroyed, and the reputation of not a few practitioners irretrievably ruined.

Fig. 154.



Gangrene from strangulation of an injured limb by absurd bandaging

Some surgeons are fond of employing the double-headed roller; but I have never had occasion to resort to it, and am satisfied that there are few cases, if any, in which it may not be advantageously replaced by the single-headed, whose application has just been described. The double-headed bandage is considered as being particularly serviceable in the treatment of wounds penetrating deep among the muscles, where it is of paramount importance to effect accurate apposition of the deep as well as of the superficial sides of the solution of continuity; but even here no indication is presented that cannot be readily fulfilled with the compress and single-headed roller. In my own practice I have certainly never been at a loss in this respect.

The bandage of Scultetus, represented in fig. 151, consists of a number of strips, generally from ten to twenty, or of pieces of an ordinary roller, of equal or unequal length and breadth, according to the intentions of the surgeon. They are arranged in such a manner as that, when applied, each succeeding one shall overlap from one-third to one-half of the preceding one, the compression being made in the same gentle, uniform manner as in the employment of the ordinary roller. This form of bandage is peculiarly useful in the treatment of compound fractures and dislocations, in connection with which it will frequently be mentioned.

Bandages are sometimes applied wet; but in doing this much vigilance must be exercised, lest shrinking too much as they dry, they produce a greater degree of compression than may be compatible with the comfort and safety of the parts. What is called the starched bandage, an excellent modern device, will receive particular attention in connection with the treatment of fractures of the extremities, to which it is more especially adapted. When it becomes dry, it forms a stiff, firm, immovable case, well calculated to maintain the ends of the broken bone in contact with each other. Amidon, gum-shellac, plaster of Paris, and other kindred articles may be used for the same purpose, the bandage being wet with them, and immediately applied to the affected limb.

The bandage, viewed as a therapeutic agent, has been much neglected by modern practitioners. No one who has properly used it, or who is capable of properly applying it, can, for a moment, doubt its great utility; my experience with it for the last twenty-five years amply attests this fact; still, it is necessary that we should temper our enthusiasm, and that we should not allow ourselves to be betrayed into a species of hobbyism, calculated to mislead the judgment, and to bring surgery into discredit. Employed indiscriminately, it cannot fail, in many cases, to cause serious mischief, and to be followed by chagrin and disappointment. When the hand of a master is not present to direct and guide our practice, the result may frequently be most disastrous both to the patient and the surgeon. The evil effects of bandages, in their aggregate capacity, are hardly less serious than those of mercury, the lancet, and other potent remedies; if they are, it is only because this agent is less frequently employed in practice. Numerous instances have come to my knowledge, where limbs, and even life, have been the forfeit of its injudicious use.

It is not difficult to perceive how the bandage acts in producing its salutary effects. In fractures and dislocations, as well as in large wounds, it powerfully controls muscular contraction, and at the same time prevents tumefaction, by giving tone and support to the capillary and other vessels. Its influence as a sorbefacient is evinced in the rapid abatement of the swelling which so often follows compression by the bandage in erysipelas, œdema, and various kinds of injuries; or, more strikingly still, in orchitis, when, after the subsidence of the more active disease, the testicle is strapped with adhesive plaster, which is but another form of bandage. Here in a short time, ordinarily in less than twenty-four hours, the swelling usually so far disappears as to allow the organ to slip out of its artificial case, or, at all events, to such an extent as to require renewal of the dressing. The general effect of the bandage would thus seem to be somewhat similar to that of mercury, controlling capillary action, and promoting the absorption of effused fluids; but it has the additional advantage, and no trifling one it is, that it supports the muscles and prevents spasm, as is so remarkably evinced in fractures and in the stump after amputation.

Of the extent to which bandaging may be carried, a good idea may be formed from the frequent allusion that will be made to it in different parts of this work; it will suffice here to observe that it is applicable, as a general rule, to the treatment of all classes of wounds, from the most simple to the most severe, to fractures and dislocations, ulcers, abscesses, erysipelas, whitlow, orchitis, chronic inflammation of the superficial veins, and to nearly all affections of the limbs in which there is an effusion of serum, or serum and plastic matter.

CHAPTER XIV.

OPERATIVE SURGERY.

OPERATIVE surgery has too often been regarded as an opprobrium of the healing art. This opinion, as foolish as it is unfounded, is not peculiar to the public, who, in matters of this kind, are generally but poor judges, but has frequently been advanced even by medical men. That this department of surgery is often abused cannot be doubted; but does it thence follow that it is a disgrace to the profession and an injury to the community? Such a view would be absurd, because it would be utterly irreconcilable with the dictates of common sense and the results of daily experience. As long as the human body is liable to accidents, and as long as nature is incapable of arresting, by her own efforts, the various morbid processes which she herself institutes, so long will practitioners be compelled to invoke the aid, and, I may add, the blessings, of operative surgery. Is it a disgrace to amputate a leg for a mortification of the foot, to extirpate a testicle that has been destroyed by cystic disease, to divide the stricture in strangulation of the bowel, to extract a stone from the bladder, to depress a cataract, or to trephine the skull in a punctured fracture? Surely, no one will doubt that in these, and a hundred other instances, our object can be attained only by an operation. Medicine, under such circumstances, however judiciously administered, is not only utterly futile, but is always ready to avail itself of the aid of surgery. Its empire is temporarily suspended, and it only resumes its legitimate functions after the use of the knife. It is true beyond doubt, and it is fortunate that it is so, that, in the hands of judicious and enlightened practitioners, a resort to instruments is much less frequent now than it was even ten years ago; many limbs which would formerly have been subjected to amputation are now easily saved, and many diseases which were once regarded as utterly hopeless now readily yield under the influence of our therapeutic efforts.

Operative surgery is progressive; it has done a vast deal, but a vast deal remains yet to be accomplished. If it has emerged out of chaos into order, and out of darkness into light; if it has laid aside its farrago of instruments, and its fondness for blood; if, in a word, it has assumed the fair and stately proportions of a science, it owes it to itself to perfect itself in the greatest possible degree, as well as in the shortest possible time, in order that it may be still more entitled to the respect and admiration of the profession, and the gratitude of the public. It is only a disgrace when it is practised for base and selfish ends; not when it interposes its resources for the purpose of removing disease and averting death.

Qualifications of a Surgeon.—The performance of operations presupposes the possession of certain qualities on the part of the surgeon. It is not every man that can become an operator, even presuming that he has the requisite knowledge of anatomy and of the use of instruments. Courage, which is so indispensable, is possessed by comparatively few; the sight of blood, and the idea of inflicting pain were so disagreeable to Haller, that, although he taught surgery with great success for seventeen years, he never, it seems, during all that time, performed a solitary operation upon the living subject. Courage, like poetry, has often been said to be a gift of nature, and nothing is, perhaps, more true; but it is equally certain that a timid man may, by attention to his education, and by constant practice, become, in the end, a good operator. Habit does a vast deal for us in such cases, for it literally becomes a second nature. I recollect a man, who in his youth nearly fainted at the sight of blood as it flowed from a vein of the arm into the basin, which it devolved upon him to hold during the operation of venesection, and yet who, by a course of self-training and a complete knowledge of anatomy, has made himself a thorough master of the knife. Celsus, long ago, happily defined the qualities which constitute a good operator. He should possess, says the illustrious Roman, a firm and steady hand, a keen eye, and the most unflinching courage, which can disregard alike the sight of blood and the cries of the patient.

But the above are not the only qualities, important though they be, which should be possessed by an operator. If he is not honest in his purposes, or scrupulously determined, in every case, to act only with an eye single to the benefit of his patient, and the glory of his profession, he is not worthy of the name which he bears, or fit for the discharge of the solemn duties which he assumes. In a word, such an operator is not to be trusted, for he will be certain, whenever opportunity offers, to employ the knife rather for the temporary eclat which may follow its use, than for the good of the individual whom he unnecessarily tortures. He will not hesitate to amputate a limb, although the patient should die the moment he is removed from the table, or to tie the carotid arteries for a malignant disease of the eye, although he knows full well that such a procedure never has, in any instance, been of the slightest benefit. Such men, of whom there are, even yet, unfortunately, too many in our profession, deserve the name of knivesman and knaves rather than of surgeons and honest men. No operation should ever be undertaken without due deliberation, and without a careful consideration of the various consequences involved in the result. Everything that is done should be done with reference exclusively to the patient; self should not have the slightest weight in the matter. The question, in every case, should be, is an operation necessary to save life, or to place the individual in a condition calculated to promote and insure his recovery? If this can be answered affirmatively, the operation should by all means be proceeded with; but if it be ascertained, clearly and satisfactorily, that it presents no such prospect, both humanity and common sense dictate the propriety of declining it. It is a sad and humiliating spectacle to see a surgeon cut off a limb, or remove a cancerous tumor, merely for the sake of having it said that he performed an operation. I am daily shocked by the reports of cases of the extirpation of malignant growths in the hospital as well as in the private practice of this and other countries. The question may well be asked, when will such silly and unmeaning, or, to use the proper expression, criminal procedures cease to disgrace our profession and to shock our sensibilities?

Every surgeon who wishes to make himself a skilful operator should have a most thorough knowledge of anatomy. His acquaintance with the healthy structures and their relations with each other should be so clear and distinct that he should be able to see them as it were in a mirror, or with his eyes shut. He should carefully study their color and consistence, that, seeing and feeling them, he may readily distinguish them from each other, and not be obliged to ask his assistants whether this is an artery, that a nerve, or this a tendon, a muscle, or a ligament. Nor should he limit himself merely to the study of healthy and relative anatomy. He should also have an intimate and comprehensive knowledge of morbid anatomy, or of the changes which are impressed upon the organs and tissues by disease and accident, and also of the various growths, formations, and deposits. The information thus derived will be of the greatest aid in facilitating the different steps of the operation, and enabling the surgeon to determine what to remove and what to spare.

No man can become an accomplished operator unless he practises constantly on the dead subject. Dexterity, grace, and elegance are to be acquired only by long and patient exercise. From what I have seen of our students, they are lamentably deficient in the use of the knife. Many of them, indeed, engage in the active duties of their profession without ever having performed a solitary operation on the cadaver, and hence it is not surprising that failure and disgrace should so often attend their early trials on the living subject. There should be, as I publicly declared more than twenty years ago, in every medical school a demonstrator of the operations of surgery, whose duty it should be to perform, in the presence of his pupils, all the operations on the dead body which it is ever necessary to perform on the living. Such exercises could not be too frequently repeated by the teacher, or too often performed by the student. In all operations involving unusual anatomical complexity, a good plan is to make a thorough dissection of the parts immediately beforehand. Langenbeck and Lisfranc always adopted this method, and I have often profited by it in my own practice.

Preparation of the Patient.—No operation, unless it be of the most trivial nature, should ever be attempted without due preparation of the patient's system. The only exception to this rule is in case of emergency, where, in order to save life, we are obliged to act on the instant, without any precaution of this kind, and sometimes even without the necessary assistants. The character and amount of the preliminary treatment must, of course, vary in different cases and under different circumstances, and do not, therefore, admit of precise specification. It may be stated, in general terms, that, if the patient be unusually plethoric and in the vigor of life, he should be bled at the arm, until he begins plainly to feel the effects of the loss, when the flow should be arrested. In opposite states of the system, however, such a procedure will not only be unnecessary, but might even be prejudicial. In all instances it is well to take into the account the probable loss of blood that will take place during the operation. If this is likely to be considerable, all preliminary abstraction must be carefully refrained from, even in healthy, robust subjects; for there can be no doubt whatever that a copious, or even a considerable, loss of blood before, during, or immediately after an operation, has a marked tendency, in many cases, to retard recovery, and to dispose to the occurrence of erysipelas, pyemia, tetanus, and other ill effects. Indeed, so thoroughly am I convinced of the truth of this remark, that I feel as if it could not be urged too frequently, or too forcibly, upon the mind of the practitioner. It was formerly thought that a certain amount of hemorrhage, under such circumstances, would not only do no harm, but that it would positively be beneficial, by rendering the system less liable to inflammation. Modern experience, however, has shown that such an opinion is utterly untenable.

It would be difficult to conceive of any case, about to be subjected to the knife, in which *purgatives* are not indicated, or in which, if they are not positively indicated, their exhibition would not be eminently beneficial. These remedies not only clear out the bowels, but they often exert a most salutary influence in modifying and restoring the secretions of the liver and mucous follicles, and it is just as much of a rule with me to prescribe them before my operations as it is to attend to the patient's diet. The best articles for this purpose are blue mass and colocynth, or calomel and rhubarb, either alone, or in union with a small quantity of ipecacuanha or tartar emetic. The latter substances are especially valuable when there is much disorder of the secretions, with headache and loss of appetite. Occasionally nothing answers better than, or hardly as well as, a dose of castor oil, Epsom salts, or citrate of magnesia. Independently of their direct cathartic effect, purgatives are often extremely useful in clearing out the bowels, where, as for example in lithotomy and in anal fistule, it is desirable to prevent any action upon them for several days after the operation.

A proper regulation of the *diet* is generally regarded, and very justly so, as of paramount importance. The extent to which this should be carried must, of course, depend upon the circumstances of each particular case; but, as a general rule, it should not, on the one hand, be too rigid or protracted, and, on the other, not too abundant. Much of the success of an operation is often directly traceable to the attention which is bestowed upon this subject. In most instances it will be advisable to enjoin entire abstinence from meat and the coarser kinds of vegetables, coffee and strong tea, hot biscuit, pastry, condiments, and, in short, all articles of an indigestible and heating nature. The quantity of food taken in the twenty-four hours should also be less than ordinary, for nearly, if not quite, as much harm may result from an undue amount of mild and unstimulant food as from the moderate use of the more solid and substantial articles.

Instead of dieting and purging the patient, it may be necessary to feed and stimulate him before it is safe to use the knife. He may be exhausted, deficient in nerve-power, or pale and anemic, requiring a rich, concentrated animal or animo-vegetable diet, milk, brandy, ale or porter, and, perhaps, quinine and iron, especially the tincture of the chloride.

Finally, attention should be paid to the state of the *body* and mind. For some days or even weeks, the most perfect quietude should be observed, especially if the operation is at all likely to be of a serious character. If, for example, the object is to extract a foreign substance from the knee-joint, or to perform an operation for the radical cure of varicose enlargement of the veins of the leg, it is hardly possible to use too much caution in this respect. In such cases the patient should not only refrain from exercise, but he should remain recumbent for several weeks, with the limb in an elevated position. In general, however, the restraint need not be carried to such an extent, a few days' confinement to the house being quite sufficient for the purpose.

The patient's *mind* should always be in as tranquil a state as possible. All business cares should be laid aside, and no outward troubles of any kind should be permitted to obtrude themselves during this probationary period. He should indulge in no unpleasant forebodings concerning the result of the operation, or, if this be inevitable, the surgeon should exert himself to the utmost to assuage and mitigate them by proper explanations. In a word, it is his duty, in all cases, to encourage the timid and console the desponding by every means in his power. A surgeon who neglects his duty in this respect is unfit to be intrusted with the lives of his fellow-beings. Many of our patients are from abroad, away from home and friends, and therefore peculiarly in need of sympathy.

I have never put off an operation on account of the particular *season* of the year. When it is recollected that the gravest accidents, requiring amputation, occur every hour of the day, and every day of the year, such a precaution would seem to be entirely at variance with common sense, if not wholly useless. I should certainly, however, not advise the undertaking of any serious operation in extremely hot weather, if it were possible to postpone it without detriment to my patient. The same objection, however, does not lie against very cold weather, inasmuch as a good fire and a properly regulated temperature of the apartment can generally be obtained, without much trouble, even in midwinter and in the most rigorous climate.

No operation, even of the most trivial nature, should be performed during the prevalence of an *epidemic.* This remark is particularly applicable to erysipelas, which, under such circumstances, is almost sure to ingraft itself upon the wound, much to the detriment both of the part and system. During an epidemic of this kind in Kentucky in 1845, '46, and '47, the slightest abrasion of the skin, a leech-bite, and the application of a blister, were often followed by an obstinate, and sometimes even a fatal, attack of the disease; and the consequence was that I was compelled, for many months, to decline the use of the knife nearly altogether.

Age is, as a general rule, no barrier to an operation. Even infants at the breast have occasionally undergone the operation of lithotomy, and in certain congenital affections, as occlusion of the anus and urethra, the knife is obliged to be used almost immediately after birth. I am, however, as will be stated in its proper place, no advocate for very early interference in harelip; and I should say that it was best, as a general rule, to put off all severe operations in infants as long as possible, for it cannot be denied that they bear the shock and loss of blood, consequent upon such undertakings, much worse than persons of riper years and more developed constitutions. Very old people often bear operations remarkably well, and recover from their effects with surprising facility. Pregnancy should always be considered as a bar to the use of the knife, except in those cases in which it is imperatively demanded to save life. Even the extraction of a tooth is occasionally followed by abortion or miscarriage, from the perturbating influence which it exerts upon the system.

The *habits* of our patients should not be disregarded in considering the question as to the propriety or impropriety of operative interference, for there can be no doubt that they frequently materially influence the result. Intemperance of every description, especially if long continued, always modifies the constitution, and renders it less able, as a general rule, to bear the shock and subsequent effects of the operation than in ordinary cases. In habitual drunkards mania à potu, erysipelas, and unhealthy suppuration are of frequent occurrence after the use of the knife. Huge feeders, or persons who are fond of the pleasures of the table, and who take little exercise in the open air, are scarcely less exempt from these affections. Inordinate sexual indulgence, the habitual loss of blood, and debility from previous suffering, often place the life of the patient in danger after a severe operation. Fat persons, and individuals of a doughy, inelastic constitution, do not bear the knife so well as the fleshy and more robust. The same is true, and in a still greater degree, of strumous people. Nervous, hysterical females are bad subjects for some operations. Hospital patients, especially in the larger cities, do not, as a general rule, possess the same tolerance of the knife as private patients.

Should females be subjected to operations during the *menstrual* period, or just before its occurrence? Of the impropriety of such a course there can, as a general rule, be no doubt, yet there may be exceptions even here. Certainly no sensible surgeon would extract a cataract at such a time, or remove a diseased mamma, or, in short, perform any serious operation, if it could possibly be postponed. But, on the other hand, daily observation teaches us that women who are badly hurt during the menstrual period often make most excellent recoveries. Hence, I should deem it perfectly proper to perform at least any of the minor operations at this time, and, in fact, almost any other where delay might prove prejudicial.

There are certain *diseases*, even some which are not of a malignant character, in which surgical interference is wholly inadmissible, either for the time being, or altogether. I allude to those cases in which the malady demanding operation is complicated with other affections. Thus, in anal fistule, associated with tubercular phthisis, no surgeon, who has any consideration for his patient, or any respect for the art and science which he professes, would think of using the knife. The anal disease, in such a case, may be regarded as nature's issue, the drying up of which would only be surely followed by an aggravation of the pulmonary symptoms. In stone of the bladder no one operates when there is serious organic disease of the kidneys, or even of the bladder itself. Amputation of a limb is never performed, except in case of accident, when there is an aneurism of the heart; nor is the femoral artery ever tied for popliteal aneurism when a similar affection exists in the arch of the aorta. In all malignant maladies, except the epithelial forms, a resort to the knife is of questionable propriety, even in their earlier stages, and before there is the slightest evidence of the carcinomatous cachexia.

Indiscriminate operations cannot be too much condemned, as they are injurious alike to the patient, the reputation of the surgeon, and the true interests of science. Like a prudent general, the surgeon should know when to retreat as well as when to advance. It is difficult to conceive of anything more laudable than a bold undertaking in a case which must prove fatal without speedy relief. At the same time, it would certainly indicate a degree of weakness, if not of absolute wickedness, to attempt an operation when there is not the slightest prospect of benefit.

There is a class of operations to which the French writers have applied the term *complaisance*, that is, operations of expediency, not of necessity. An individual, for example, has an infirmity, as a distorted foot, or a contracted finger, which is a source rather of annoyance than of suffering or even positive inconvenience; his pride is piqued, and, as a consequence, his mind is incessantly disturbed by it, so much so, perhaps, as to be wholly disqualified for business and social enjoyment. Such persons often importune the surgeon's aid, and it therefore becomes a nice question how he should govern himself in regard to them. Shall he advise an operation, and run the risk of killing his patient, or shall he refrain, and persuade him to bear his cross, for such it actually is? There can, I think, in general, be very little difficulty in arriving at a proper conclusion in such a state of things. For myself, I can see no difference between the physical suffering that is induced by a diseased bone and the mental distress that results from a deformed foot; as far as their effect upon the comfort and happiness of the individual is concerned they are precisely on the same level, and hence, if it be right and lawful to amputate in the one case, why should it not be in the other? If a young man has a varicocele, even of moderate size, and it completely destroys his happiness and usefulness, not by its physical but by its mental effects, is it not our solemn duty to attempt relief by an operation, although the attempt should jeopard his life? I must confess, I should not hesitate as to the line of conduct to be pursued under the circumstances; at the same time, however, I should not omit to warn my patient of the risk he would be likely to run, and if, after a thorough explanation of the whole matter, he should still persist in his desire to be operated on, I should use every possible precaution, by a course of diet, purgatives, and rest, to put his system in the best possible condition for sustaining the shock of the approaching ordeal. Operations involving the same principle, though not the same risk, are of daily occurrence, and few surgeons hesitate to perform them; I allude to the division of tendons in club-foot and strabismus, the extraction of the crystalline lens in cataract of one eye, when the other eye is sound, and other analogous affections.

Assistants.—There are but few operations which a surgeon can perform alone; in general, he is obliged to have assistants, and the number of these must necessarily vary in different cases and under different circumstances. Sometimes only one is required; at other times two, three, four, or even half a dozen will hardly suffice. The more simple an operation the less aid will commonly be necessary. In lithotomy an assistant holds the staff, two others support each a leg, one administers chloroform, another takes charge of the patient's hands, and a sixth presents the surgeon his instruments. In depressing a cataract, the operator usually requires only one assistant, to support the head and upper eyelid. Operations on children, especially when we are not permitted to employ anæsthetics, are often peculiarly embarrassing, and demand an unusual amount of aid for their successful execution.

The beauty, elegance, and rapidity, nay, even the success of an operation, are often marred by the awkwardness of the assistants. To act well their part, they should be thoroughly acquainted with the different steps of the operation which is about to be performed, as well as with the nature and relations of the structures involved in it, so as to be able to anticipate every thought and wish of the principal. It is not necessary that they should be compelled, like so many Thespians, to rehearse the part which they are expected to play in the approaching task; but we should see that they are properly instructed in their business, and that they all perfectly understand their duty, which should always be carefully explained and assigned beforehand. Nothing can be more awkward for a surgeon than to stop in the midst of an operation to ask for a knife, sponge, or ligature; once begun, everything should proceed with the utmost regularity, and without the slightest interruption from any cause. Good, well-trained assistants are, unfortunately, not always to be obtained; the older members of the profession are too much occupied, or too jealous of each other, to afford their services, and the younger are too often ignorant of the duties required of them.

Duty of the Surgeon.—When the surgeon has a perfect control of his time, as he almost always has, except in cases of emergency, he generally selects a particular hour for performing the operation. The best period of the day, at least in this country, is from 11 to 2 o'clock, as he will then have a good light, and also be in a better trim for the discharge of his duty. An operation, especially an important one, should never be performed late in the afternoon, or in cloudy weather; for, should hemorrhage arise, he might be sadly puzzled in his attempts to arrest it, on account of the want of a good light, which is so indispensable on such occasions.

At the hour specified for the operation everything should be in its place; the assistants should attend with military punctuality; the table should be properly prepared; the chloroform, ammonia, and brandy, instruments, ligatures, sponges, water, and napkins, should all be at the precise spot where they are required; in short, nothing should be wanting, but everything be at hand, and arranged in the most perfect order. I have heard of a surgeon, engaged in an amputation, make his flaps, and ask for his saw, which had been left in an adjoining room! On one occasion a lithotomist performed the lateral section, and was about to introduce the forceps to extract the stone, when, lo and behold, the instrument had not been put on the tray! Such blunders might create a smile, if they did not sometimes involve serious consequences. It need hardly be added that all these preparations should be made in an adjoining room, away from the patient; it is enough for him to know that he is about to suffer, without seeing the instruments of his torture deliberately spread out, one after another, before his eyes.

Of the precise time, as to the day and hour, of the operation, the patient should usually be kept in ignorance, as the information, if made, could hardly fail to exert a perturbating, and, consequently, a prejudicial influence upon the mind, and, through it, upon the general system. It is only in the milder cases that this intelligence should be communicated. There is, however much difference in this respect in different individuals, for, while some would shrink from the disclosure, and be, perhaps, seriously affected by it, others will not only be indifferent to, but absolutely court it.

Position of the Patient and Surgeon.—The position of the patient, the surgeon, and the assistants must vary, of course, in different cases, and can be discussed here only in a general manner. When chloroform is to be given, absolute recumbency is required, to guard not only against delay, but also against the occurrence of serious mishaps. But, apart from this consideration, the horizontal posture should always be preferred whenever the operation is likely to be protracted, or attended with much shock and loss of blood. In other cases, again, as in lithotomy, the operation cannot be performed in any other position than in the recumbent. In amputating the thigh and leg, as well, indeed, as the arm and forearm, the patient always lies down, not only on account of apprehended weakness, but because it is always easier, when he is thus placed, to hold the limb and control hemorrhage. In lacerating a cataract, the patient generally sits in a chair, with his head supported upon the breast of an assistant; in operating on hare-lip, the child usually sits upon an assistant's lap, the head being firmly held by another assistant, standing behind or by the side of the first. In lithotomy, the patient lies on his back with the breech reaching over the edge of the table, two assistants support the legs, another holds the staff, a fourth takes charge of the sponges, and a fifth administers chloroform, while the surgeon sits on a low stool in front of the perineum, or, as I usually prefer, rests on one of his knees. Now that anæsthetic agents are so much in vogue, it is seldom that we are obliged to tie our patients, or to roll them up in sheets or aprons, as was the custom prior to the discovery of these most useful remedies.

OPERATION.—Everything being thus prepared—the assistants being at their posts, the instruments arranged upon a tray in the order in which they are likely to be required, the parts divested of hair and dressings, and the patient fully under the influence of chloroform—the operation is proceeded with, slowly, deliberately, and in the most orderly, quiet, and dignified manner. All display, as such, is studiously avoided; ever remembering, in the language of Desault, that the simplicity of an operation is the measure of its perfection. No talking or whispering should be permitted on the part of the assistants, and as to laughter, nothing could be in worse taste, or more deserving of rebuke. Every important operation should be looked upon as a solemn undertaking, which may be followed in an instant by the death of a human being, whose life, on such an occasion, is often literally suspended by a thread, which the most trivial accident may serve to snap asunder.

The time occupied in performing an operation is a matter of some moment, but not as much, perhaps, as is commonly supposed. When a patient is unconscious, whether from cerebral oppression, or from the use of an anæsthetic agent, it is of very little consequence, other things being equal, whether the operation lasts five minutes or ten minutes, provided it is well executed, which it certainly cannot always be when we aim at great speed. Le Cat, it is said, lithotomized half a dozen patients in nearly twice as many minutes, and the result was that he lost nearly every one. Prior to the application of chloroform to the relief of suffering, rapidity was most commendable, inasmuch as it served to prevent shock and pain, though I firmly believe that it was often secured at the expense of much subsequent mischief, if not immediate detriment. The maxim of the schools has always been *cito, tuto et jucunde;* but, as it respects the first of these injunctions, it may be added, in the language of Cato, *sat cito si sat bene.*

Accidents during Operation.—The next topics to be considered are the accidents which are liable to take place during the operation, and the best methods of avoiding or meeting them. These are, first, hemorrhage, and secondly shock.

The amount of blood lost during an operation may be very small when measured by ounces, but very large in relation to its effects upon the system. Much will depend, in every case, upon the state of the constitution, and the temperament, habits, and health of the patient. A hemorrhage which may affect one individual very slightly, if, indeed, at all, may affect another most seriously and even fatally. A good deal, again, will depend upon mere idiosyncrasy, and upon the presence or absence of epidemic disease, which, as has already been intimated, generally impresses itself, to a greater or less extent, upon every individual in the community in which such disease prevails. Anything like a copious loss of blood is, as before stated, a great evil, and should, therefore, always, if possible, be prevented. I cannot agree with those who think that the loss of twelve, sixteen, or twenty ounces will be likely to be beneficial, even when there is unusual vigor of constitution. If there be any undue vascular repletion, it can always be relieved, if the necessity for it arises, after the operation is over. In all cases, therefore, I deem it to be our duty to guard against hemorrhage as much as possible.

It is not necessary, nor even proper, to tie every vessel as fast as it is divided. A well-trained assistant will generally obviate this necessity by compressing the bleeding orifice the moment the knife has swept beyond it, and by the proper exercise of this dexterity a large tumor may often be removed before a single ligature is applied. Should the bleeding, however, not be controllable by this means, measures must be adopted to arrest it without delay by ligating the principal vessels from which it proceeds.

It is seldom, at the present day, that a patient sustains anything like a serious shock from an operation, even if it be comparatively severe and protracted. The use of anæsthetics, if it do not always effectually prevent, generally restricts it within the limits of tolerance, and thus saves the surgeon a vast amount of trouble and anxiety. It is not, however, to be forgotten that the very means which are employed to prevent pain and shock may themselves induce severe, if not fatal, prostration. Hence, as will be seen by and by, too much caution cannot be used in their administration; the effects of the remedy should be most carefully watched throughout, so that any symptom denotive of danger may be instantly recognized and counteracted. By keeping the patient perfectly recumbent, and providing for the free admission of air into the lungs, all mischief may, in general, be happily avoided. The syncope, caused by the loss of blood, is met by a depressed position of the head, by means of the fan, by dashing cold water upon the face and chest, by holding smelling-bottles *near*, not to the nose, and, in severe and alarming cases, by sinapisms to the extremities, spine, and præcordial region, aided, if necessary, by the use of stimulating injections, as brandy, turpentine, ammonia, or mustard.

Dressings and After-treatment.—The operation being over, the next thing to be done is to adjust the dressings; these should always be as light as possible, and applied in such a manner as to insure the greatest chance for union by the first intention. The question has been much agitated, of late years, whether the dressings should be applied at once, the moment the knife has accomplished its object, or whether the parts should be permitted to remain free for several hours, to afford them an opportunity of contracting and becoming glazed with plastic matter. Much might be said in favor of both methods. The proper rule of practice, I think, is to steer a middle course, adopting neither plan exclusively. In large wounds, as those, for example, left in amputation of the thigh, leg, or arm, and in the extirpation of large tumors, the best plan always is to keep the parts open for three, four, or five hours, or until all oozing has ceased, and the raw surface has become incrusted with plastic matter, a light and porous napkin, properly folded and frequently wrung out of cold water, being kept constantly applied to promote these occurrences. If, under such circumstances, approximation be effected immediately after the operation, the surgeon will often be compelled, a short time afterwards, even when he has taken the greatest possible care to secure the vessels, to remove his dressings, in order to arrest the flow of blood; a procedure which is generally not less painful and alarming to the patient than disagreeable and vexatious to the attendant. If, on the other hand, the wound be small, the best plan, I conceive, is to bring the edges together at once, as this saves both time and anxiety.

The dressing being applied, the patient is carried into his bed, previously prepared for his accommodation, and placed in such a position as will best promote his comfort and the reunion of the divided parts. Feathers and heavy quilts are to be carefully avoided; and, in general, it will be well, especially if there is a probability of there being much discharge, whether of blood, secretion, or excretion, to protect the bedding with a piece of thin, soft oil-cloth, spread beneath a folded, movable sheet. The affected parts are placed in an elevated and relaxed position, and maintained, throughout, in a cool, comfortable state. The diet must be light and unirritant, the drink cooling and palatable, and the temperature of the apartment from sixty-five to seventy-five degrees of Fahrenheit. All unnecessary conversation should be avoided; and no persons, except the nurse and the immediate friends of the patient, should be permitted to enter the room during the first twenty-four hours after the operation, or, in cases of great danger and severity, not until a much longer time.

When the operation is at all severe, my invariable rule is to administer a full dose of morphia immediately after it is over, or even sometimes an hour or two before it is commenced. The object is not only to allay pain, which is always a great desideratum, but to induce sleep and tranquillity of the system; in other words, to put the part, body and mind, all in a state of absolute repose for at least the first twenty-four hours after the use of the knife. By a full dose of morphia, I mean not less than one grain; a smaller quantity than this would only serve to fret and worry the patient, instead of composing him. In cases of unusual severity, I do not hesitate to give twice that quantity, never forgetting that excessive suffering always establishes a certain amount of tolerance to the use of anodynes.

Too much attention cannot be bestowed upon the patient's diet. If the operation has been at all severe, or attended with unusual shock and loss of blood, he must be fed, not starved, in order to enable the system to reinstate itself as promptly as possible into its former condition, by the manufacture of blood and nervous fluid, both, perhaps, frightfully expended during the previous contest, and now in danger of being still further exhausted by the traumatic fever and the tumultuous action of the heart. The vessels must be replenished; the brain and spinal cord supported. The most suitable articles for this purpose are milk and stale bread, with the free use of brandy, followed, in a day or two, by animal broths, beef essence, rich soups, and the lighter kinds of meats. Sub-acid fruits will also generally prove both grateful and nourishing. The drinks should consist of ice water, either pure or acidulated, as may be most agreeable to the patient. A cup of tea is often exceedingly soothing and refreshing soon after a severe operation. Starvation after severe shock and loss of blood is often followed by the worst consequences, from the tendency which the system has to run into erysipelas, pyemia, and hectic fever, to say nothing of its incompatibility with the adhesive process.

But patients must not be fed indiscriminately after operations; when the individual is young and robust, perfectly temperate in his habits, and, above all, when he has not suffered severely from shock or loss of blood, his diet should be restricted and be of the blandest character for a number of days, or, in fact, until the wound left by the knife is in great measure healed. Improper indulgence, under such circumstances, cannot fail to light up a fire which hardly anything afterwards may be able to extinguish.

Attention to the temperature of the patient's apartment is often a matter of great moment; in general, it will be best to regulate it by the thermometer, especially in operations on the respiratory organs, and after the extirpation of ovarian tumors. Everything like a direct draught must be carefully avoided, and in wet weather it will be a good plan to shut the windows.

Some of the above precepts may seem trivial; but I am sure that they are of the greatest importance, and that the want of their observance is often followed by the worst consequences. It is a much easier matter to talk a patient to death, or to retard his recovery, after he has undergone a severe operation, or sustained a violent injury, than most people imagine. Should symptomatic fever arise, or should the parts exhibit evidence of over-action, prompt recourse must be had to the usual antiphlogistic remedies, employed in a decided yet cautious manner, lest they produce harm instead of good.

The after-treatment should always, if possible, be superintended by the surgeon himself; his duty is not over with the operation; it ceases only with the cure or death of his patient. "The practice," remarks an eminent authority, "of performing a serious operation, and leaving the after-treatment to others, has, in my knowledge, repeatedly proved disastrous. The medical treatment, a duty not less responsible than the operative, belongs to the surgeon; and, indeed, to be employed merely as a handicraftsman, conveys an imputation at which the dignity of a scientific mind revolts."

Sources of Danger after Operations.—The great sources of danger, after a severe operation, are, first, excessive depression of the system from shock and loss of blood; secondly, traumatic fever; thirdly, undue inflammation of the parts; fourthly, secondary hemorrhage; fifthly, erysipelas; sixthly, pyemia; seventhly, tetanus; and, lastly, constitutional irritation.

a. The *prostration*, consequent upon an operation, is usually denoted by great pallor of the countenance, feebleness of the pulse and respiration, coldness of the extremities, yawning and sighing, partial blindness, dizziness, noises in the ears, restlessness, thirst, nausea, and even vomiting. To meet these symptoms, all that is necessary, in general, is to place the patient recumbent, to use heat, friction, and sinapisms, to allow a free access of air, and to administer stimulants, as brandy, or brandy and ammonia, by the mouth, if the power of deglutition still remains, or, if not, by the rectum, in the form of enemata. A full anodyne will usually form a most valuable adjunct to these remedies, and should seldom, if ever, be omitted. Great care, however, must be observed in the management of these cases, lest violent reaction follow the depression, and hurry the patient on to a fatal termination. It is only in instances of extreme prostration that stimulants should be given boldly and freely, and without any regard to future consequences in respect to the parts involved in the operation.

b. More or less *fever* must almost necessarily follow every severe operation, offering thus an additional source of suffering and danger to the patient, and of anxiety to the surgeon. To this disease the term traumatic is usually applied; the older writers called it bed or wound fever, and Dr. Simpson has recently given a most excellent account of it under the name of surgical fever.

It generally begins within the first six or eight hours after the operation, and is characterized by a flushed appearance of the face, a frequent, quick and irritable state of the pulse, dryness of the skin, restlessness, and thirst, which is often excessive, especially after profuse losses of blood. In some cases there is extreme jactitation, with nausea, if not actual vomiting, and a tendency to delirium, or a confused and bewildered condition of the intellect. The breathing is generally somewhat hurried, and slight mucous râles are often present. The appetite is impaired or entirely wanting, the bowels are constipated, and the urine is scanty, high-colored, and often offensive, being surcharged with saline matters and occasionally even slightly albuminous. Now and then the disease is ushered in by distinct rigors. After the fever has continued for some time a tendency to remit appears; the heat, thirst, and restlessness diminish, the pulse descends, the gastric distress vanishes, and the skin becomes covered with a gentle moisture, which often increases to profuse perspiration.

The duration of traumatic fever varies from a few hours to a number of days. In the milder cases, it is generally very evanescent, while in the more severe it is often quite protracted, and is then usually attended with regular vesperal, if not also matinal, exacerbations. Not unfrequently the disease disappears entirely for a few days, and then recurs, with more or less violence, the attack being provoked either by some dietetic or other indiscretion on the part of the patient, or by some change of the system, as the arrest of an important secretion, or the commencement of blood-poisoning.

The causes of surgical fever are sufficiently obvious. Every operation of the slightest severity acts as a disturbing agent, depressing the vital powers, and deranging, as a direct and inevitable consequence, all the secretions. We have familiar illustrations of these occurrences in daily practice, in the lancing of boils, the extraction of teeth, and in the operation of bleeding. The least shock, however induced, is sure to be followed by more or less general disorder, and it is hardly necessary to state that the amount of this disorder is always materially augmented when, in addition to the nervous lesion, there has been considerable loss of blood. Nothing so rapidly, or so powerfully, irritates and frets the vascular and nervous systems as these two circumstances. The heart evinces its suffering first, by the feebleness and irregularity, and, after the occurrence of reaction, by the frequency and rapidity of its contractions. The nausea and vomiting, the excessive prostration, the yawning, and confusion of intellect, not to mention other symptoms, are unmistakable signs of the shock, or loss of power, sustained by the great nervous centres. The use of anæsthetics, doubtless, often contributes to the production of traumatic fever, by the disturbance which it occasions in the general system.

Now, if we take all these circumstances into view, and the fact that thousands of patients are subjected to operations without due preparation of the system, or, indeed, any preparation at all, as in cases of primary amputations, trephining, and the ligation of the larger arteries for the arrest of hemorrhage in gunshot and other wounds, it is certainly not necessary to invoke the agency of blood-poisoning, as is of late so frequently done, to account for the occurrence of traumatic fever. These causes are all sufficient to create the most violent disturbance; or, in other words, to set the whole system in a perfect state of ferment, overturning all its functions, and thus occasioning an amount of reaction capable of destroying life in a few hours, or, at all events, in a few days. While this perturbation is progressing, other and still more serious consequences may ensue, as erysipelas, pyemia, and effusions into the splanchnic cavities, the result of disordered secretion, and of the retention of hurtful matter, eventuating in a diseased state of the blood, and in a predisposition to local inflammation in parts more or less remote from the seat of the original injury. The constitutional derangement will, of course, be materially increased if, in addition to these disturbing agencies, there is an absorption or ingress of foul pus into the system, constituting toxæmia, or blood-poisoning.

The danger in traumatic fever is often very great, and it is, therefore, impossible to watch the patient too attentively. The risk will be particularly imminent if the disease is very violent, or the system was much prostrated prior to the operation. The danger will then be twofold; first, from constitutional irritation and fatigue of the heart, leading to paralysis of its fibres; and, secondly, from internal congestion and local inflammation.

The proper remedies are cooling drinks, taken in moderation, or ice, if there be nausea, or gastric oppression; sponging the surface with cool or tepid water; mild laxatives; and the neutral mixture, or camphor water, with a minute quantity of antimony and morphia, to promote diaphoresis. If the symptoms are disposed to continue, more active measures may be required, especially purgatives, assisted, perhaps, by a few grains of calomel, particularly when there is marked disorder of the secretions. The lancet is seldom, if ever, to be brought into requisition in any case. Leeching, cupping, and blistering may be necessary when there is congestion, or threatened inflammation of important internal organs. Local remedies must, of course, not be neglected. If the fever be obstinate, quinine will be indicated, combined, if there be profuse sweat with a tendency to hectic, with iron and elixir of vitriol. Great attention is paid to cleanliness and ventilation.

This febrile commotion of the system is sometimes very deceptive, exhibiting an appearance of great violence, when in reality it is most slight, promptly yielding to the most simple remedies, or subsiding of its own accord. It resembles a sudden and violent storm, quite alarming, but altogether transient and harmless.

c. The resulting *inflammation* will rarely exceed the adhesive limits, if proper care has been taken to prepare the patient for the operation, and the parts have not been too roughly handled during its performance. But prevention is not always possible, and hence the wound should be diligently watched, lest it be assailed, and even overwhelmed before the patient and his attendant are aware of the fact; for it should be remembered that the morbid action is not always characterized, under such circumstances, by the usual symptoms; there may even be an entire absence of pain and tension, perhaps even of discharge. Great vigilance, therefore, is often necessary to detect the earliest inroads of the disease, and to counteract its progress. Of course, all officious interference is avoided, and nature is carefully protected in the maintenance of her rights and privileges. The moment over-action is perceived, the dressings are either removed, or, at all events, slackened, and suitable means substituted. Of these the most important consist of leeches, water-dressings, and cataplasms, either simple or medicated, according to the exigencies of the case. If matter form, free vent is afforded, either by a change of position of the parts, or by puncture and incision. Constitutional treatment, of course, receives due attention.

d. Secondary hemorrhage may come on within a few hours after the adjustment of the parts, or it may be postponed to a later period, even to a few days or weeks. It may be arterial or venous, slight or profuse, transient or persistent, just as in the primary form of the accident. The most common causes are, imperfect ligation of the vessels, defective dressing, sloughing, and premature detachment of the ligatures. Whatever they may be, they should be carefully sought out, and at once counteracted by appropriate measures. The occurrence is always to be deprecated, because it has a tendency, not only to alarm the patient and his friends, but to impede and even prevent the adhesive process, requiring, as it not unfrequently does, the reopening of the wound for its successful management. Fortunately, however, it is, in general, easily avoided, especially if proper attention be paid to the dressings and after-treatment.

e. *Erysipelas* is most apt to occur in persons of intemperate habits, or of a broken-down constitution, and usually makes its appearance within the first three days after the operation, generally at the site of the wound, or in the parts immediately around. Its presence is always denotive of disorder of the digestive apparatus, and hence one of the first things to be done is to administer medicines calculated to clear out the bowels and to restore the secretions of the liver, the mucous follicles, and the salivary glands. For this purpose the best articles are calomel and compound extract of colocynth, or blue mass and rhubarb, followed, if necessary, by the saline and antimonial mixture, with anodynes to allay pain and procure sleep. The local treatment must consist, mainly, of the dilute tincture of iodine, and solutions of the acetate of lead, with punctures and incisions to relieve tension and afford vent to effused fluids.

f. *Pyemia* may set in almost at any time after an operation, but the most common period is from the third to the eighth day. It is usually ushered in by bold and well-marked symptoms, such as violent rigors alternating with flushes of heat, severe cephalalgia, aching pains in different parts of the body, excessive restlessness, great thirst, a quick and frequent pulse, and inordinate dryness of the cutaneous surface. Delirium and extreme prostration soon ensue, and thus the case progresses from bad to worse, until, frequently in less than a week from the commencement of the attack, the patient expires in a state of utter exhaustion. Little is to be done for a system thus assailed. In nine cases out of ten the disease proves fatal. The proper remedies, at the start, especially if the patient is robust and plethoric, are moderate venesection and leeching, the exhibition of the milder purgatives, as calomel and rhubarb, and mercury with a view to a rapid constitutional impression. When excessive prostration is threatened, brandy, wine, ammonia, and nourishing broths are indicated, and must be administered with a generous hand. Locally, besides leeching, iodine, blisters, and medicated fomentations will be advantageous; if matter form, early and free incisions are made.

g. Still worse than pyemia, because even more fatal, is *tetanus*. This, however, is fortunately a rare occurrence after operations in this country. It is most common in tropical regions. In Europe and North America it is met with chiefly in dissipated persons of a broken-down constitution. It would seem that in India the operation of lithotomy is occasionally followed by this disease, an effect which, so far as I know, has never been witnessed in this country. Excessive loss of blood, severe shock, and exposure to currents of air, undoubtedly predispose to the occurrence of the affection, which usually shows itself within the first five or six days after the operation. The principal remedies are, anodynes, in full and sustained doses, brandy and ammonia, chloroform, and emollient applications to the wounded parts.

h. Life may be assailed by *constitutional irritation* and profuse discharge, and that, too, long after all apparent danger is over. The patient gradually becomes hectic; his appetite and sleep fail; the bowels are irregular, at one time constipated and at another relaxed; and the parts, exhibiting an unhealthy aspect, refuse to heal. Such a state of things, which, in general, but too surely foreshadows an unfavorable result, is to be combated upon the same principles as hectic produced by ordinary causes.

i. Patients sometimes *die* suddenly and unexpectedly after operations without any ascertainable cause, and where, at the time, everything seemed to be in a promising condition as to their ultimate recovery. A more sad and distressing occurrence can hardly be thought of, and yet it is one which cannot always, there is reason to believe, be avoided, no matter what precautions may be observed. Mere loss of blood, or shock, is not always sufficient to account for this unfortunate event, although it, doubtless, in many instances, materially contributes to its production; for death not unfrequently happens where no such effects were witnessed. Nor can it be due to the introduction of air into the veins, as, for example, when operations are performed about the neck, inasmuch as, in this case, the patient either perishes instantaneously, or, at any rate, exhibits unmistakable evidence of the accident. Besides, this occurrence is not peculiar to operations upon the cervical region, but has been witnessed in operations upon all parts of the body, even in some of the more insignificant amputations and the removal of small tumors. When there has been much loss of blood, or severe shock, the event is probably due, at least for the most part, to syncope, or actual paralysis of the heart, preventing this organ from transmitting a sufficiency of blood to the brain for the due performance of its functions; and such an effect is most likely to take place when the patient, through neglect, wilfulness, or mismanagement, sits up in bed, or stands on the floor, thus suddenly depressing the heart's action. In this way life is sometimes instantaneously destroyed in lying-in females, especially in those who have suffered seriously from hemorrhage; and similar results are occasionally witnessed after surgical operations and accidents. In another class of cases, death is probably caused by embolism, that is, by the formation of heart-clots, and of fibrinous concretions in the vessels, impeding the passage of blood, and so arresting, suddenly and unexpectedly, the functions of an important organ. It is well known that copious hemorrhage, or severe shock, invariably renders the blood more coagulable, and hence such a state of the system must be regarded as powerfully predisposing to the occurrence of embolism.

It is sufficient, for all practical purposes, to know that such an event may occur after operations, without any formal attempt at its solution, which the present state of the science hardly enables us to do. Whatever the cause may be, no efforts should be spared to prevent it. For this purpose, the utmost care should be taken, after all serious operations, not to prop the patient up in bed, or to let him get upon his feet; nay, further, he should not, if he is very weak or exhausted, be permitted to move about in bed, or, in short, to do anything calculated to induce syncope, or promote the occurrence of embolism. The diet should be of a suitable kind, and such medicine should be given as shall have a tendency to give tone and strength to the system. Free use, in particular, should be made of brandy and milk. If syncope occur, the head must immediately be placed low, and recourse be had to sinapisms and stimulating injections, to reassure the heart, although this will probably be in vain, especially if the cause of the failure of its action be the presence of a clot, either in its own cavities or in some vessel. As it is impossible to foretell, in any given case, when the patient may be exempt from sudden death, after severe shock, or great loss of blood, the precautions here enjoined should be rigidly observed until there is reason to believe that all danger from this cause is passed.

j. The *mortality* of surgical operations is subject to numerous contingencies, some of which have an intimate relation with the patient himself, some with the nature of the injury, or accident necessitating the interference, and some with the surgeon, either directly or indirectly. It may be assumed, as a general rule, that all the capital operations, as they are termed, are attended with a certain degree of risk to life, while not a few of the minor or more insignificant ones have, from causes which it is not always easy to determine, a fatal issue. It has been asserted by an eminent authority, Professor Simpson, that a patient who is about to undergo a severe operation incurs as much danger as a soldier engaged in the most fierce and bloody battle. This is a strong declaration, but I believe it to be fully borne out by facts; nevertheless, it must be received with some degree of reserve. If a man serves as a forlorn hope, he will stand a fair chance of being killed; and so precisely with a patient who submits to the knife on account of some terrible accident or disease. But such cases constitute the exception, not the rule; under ordinary circumstances, if the system is properly prepared, and the operation well performed, the surgeon looks with great confidence for a good recovery. If he could always select his cases, the general result would be very different. He would then not employ the knife against his judgment, as a dernier resort, with the certainty that there was hardly one chance out of a hundred for a favorable issue; he would let all the bad, desperate, or unpromising cases alone, to get well or perish, as a kind Providence might direct. But so long as a surgeon has any feelings of humanity he cannot do this; he must take the good, bad and indifferent cases as they present themselves, and do the best he can with them. It is only when he is guilty of neglect, or of serious mismanagement, that he should be considered culpable. He does not expect to save all; he knows that many must necessarily perish, not so much as an effect of the operation as of the injury or disease for which the operation is performed, and in attempting to estimate the probable result of his interference, he does not forget to take into the account the risk which his patient is obliged to incur from hemorrhage, erysipelas, pyemia, tetanus and other intercurrent but often unavoidable affections. He is assured that there is no case, however desperate, that may not recover, or one, however insignificant, that may not perish.

The following tables will serve to show what has hitherto been the mortality after some of the so-called capital operations:—

Operations.	Cases.	Recoveries.	Deaths.	Proportion.
Lithotomy . . .	7,874	6,792	1,082	1 in $7\frac{5}{18}$
Ligation of arteries . .	401	287	123	1 in $3\frac{1}{4}$
Herniotomy . . .	622	326	296	1 in $2\frac{1}{10}$
Amputation of the thigh .	1,642	907	735	1 in $2\frac{1}{4}$

But these results, so humiliating to surgery, refer chiefly to hospital practice, and can, therefore, hardly be considered as affording a fair average of the experience of the profession in general. The great majority of the most desperate cases, both of injury and disease, in all large towns and cities, find their way into public institutions, where they rapidly sink under the joint influence of vitiated air, erysipelas, pyemia, and want of proper attendance. It is a notorious fact that many more patients recover after bad injuries and severe operations in the country than in the city; and, to go no further, it may confidently be asserted that an experienced operator will lose fewer cases than one who is just commencing his career.

CHAPTER XV.

PLASTIC SURGERY.

PLASTIC SURGERY is that branch of the subject which treats of the restoration of lost parts by the transplantation of healthy integument from some neighboring region. Originally restricted to the repair of the nose, it has, during the present century, busied itself, in different ways, with the emendation of various other organs, and has thus greatly enriched the domain of general surgery; having, in fact, created a new department of operative medicine, as fertile in its resources as it has already been brilliant in its results. The perfection which plastic surgery has attained within the last twenty years is truly wonderful, and affords a striking evidence of the ingenuity, talent, and enterprise of the medical profession in different parts of the world. It has literally been a field of conquests, upon which have been achieved some of the proudest triumphs of the human mind in modern times. Among the many names that are honorably associated with this department of surgery, on account of their persevering efforts to advance its interests, those of Carpue, Dieffenbach, Blandin, Zeis, Jobert, Serre, Liston, and Von Ammon, of Europe, and Pancoast, J. M. Warren, and Mütter, of this country, hold deservedly a high rank. Several of these surgeons have composed able treatises on plastic surgery, and have thus indelibly identified their names with its history.

Various names have been devised to designate this branch of surgery. Thus, Blandin denominates it autoplasty, from a Greek compound literally signifying self-creation. Another French authority, Mons. Velpeau, prefers the word anaplasty, the true meaning of which is reconstruction. By others the term plastic, from the Greek verb to mould, model, or adjust, is used, and this is perhaps less objectionable than any other; at all events, it possesses the advantage of being easily understood.

It is exceedingly probable that one branch of plastic surgery has been practised in India from time immemorial. In that country the barbarous custom has existed for ages of punishing certain classes of criminals by cutting off their noses, and there can be no doubt that sympathy for these poor wretches gradually induced persons to turn their attention to the means of affording them relief. Hence arose rhinoplasty, or the operation of making new noses, pursued chiefly by a low order of native priests, whose ignorance of the healing art was too profound to justify the idea that their efforts were often crowned with success. According to Galen, the ancient Egyptians were well acquainted with rhinoplasty, but self-interest and pride prevented them from communicating a knowledge of it to other nations. Whether the operation was ever performed in Greece and Rome history does not inform us, although it can hardly be supposed that, if it had been, it would have been silent on the subject. In Europe attention was first prominently drawn to the restoration of lost parts by Gaspar Taliacotius, Professor of Anatomy and Surgery in the University of Bologna. In a work on the subject, remarkable for its erudition, and the simplicity of its diction, published at Venice, in 1597, he has described with great minuteness the art of repairing mutilated noses, lips, and ears, illustrated by numerous engravings. It bears the title of "De Curtorum Chirurgia per insitionem," and is curious as furnishing a record of the observation and experience of a truly great surgeon soon after the revival of learning. His practice must have been very great as a rhinoplastic surgeon, for it is distinctly stated that patients visited him from all parts of Europe. The pupils of Taliacotius, settling in different parts of the continent, took great pains to disseminate a knowledge of the operation among the profession, although it does not seem to have been often applied in practice, doubtless from fear of failure. The operation, moreover, was doomed to encounter many obstacles from ridicule, which always exerts a powerful influence upon the weak and prejudiced in every country, and not unfrequently has the effect of throwing a new and useful invention completely into the shade.

The method of Taliacotius consists in borrowing the required material from the arm; the operation is very tedious and complex, and has been almost entirely superseded by the Indian method, in which the flap is taken from the forehead. These two processes will be described in their proper place. Meanwhile, it may be observed that the Oriental operation was first successfully performed in Europe in 1814, by Mr. Carpue, of London, who, in 1816, published an account of this and of another case, equally fortunate. To Dieffenbach, however, more than to any one else, is due the merit of having first generalized the operation, by pointing out the sphere of its application.

The nomenclature of these plastic operations has assumed quite an imposing character, from the numerous structures to which they are applicable. It is formed by adding the word plasty to the anatomical name of the part concerned, as rhinoplasty, genoplasty, and urethroplasty. Before I proceed to speak of these operations separately, it will be necessary to offer some remarks of a general nature respecting the causes which necessitate them, the preparation of the system, the proper mode of conducting them, and the character of the after-treatment.

The causes necessitating these operations are various kinds of accidents and diseases. Thus, in India, as already stated, rhinoplasty is generally required on account of wilful mutilation of the nose as a punishment for crime; in Germany, on the contrary, it is often called for on account of injury sustained by the small sword in duelling. The vicious cicatrices left by burns and scalds frequently led to the necessity of their performance; in fact, a large field for plastic surgery has been opened in this class of lesions, in which good service was rendered by the late Dr. Mütter, since attention was first directed to it. Of the various diseases which may create a necessity for this kind of interference, carcinoma, struma, and syphilis occupy the first rank, these affections not unfrequently destroying the greater portion of the nose and lip, and thus causing the most disgusting deformity. Genoplasty is generally required on account of ulceration of the cheek from the effects of mercury; and urethroplasty, in consequence of urinary fistule, the result generally of stricture and abscess.

Whatever may be the causes leading to the necessity of these operations, none should ever be undertaken without thorough preparation of the system, extending through a number of days, if not several weeks. Upon this subject it is impossible to insist too strongly. I have seen enough of these cases to satisfy me that too little attention is paid to preliminary treatment, and that most of the failures which attend the procedure are due to the neglect of this precaution, for which there is the less excuse, seeing that there is never any need of immediate interference. There is no necessity, unless the patient is very plethoric, for the use of the lancet; light diet, rest, and an occasional purgative will generally suffice to bring down the system to a proper point of tolerance for the approaching ordeal. If the patient is from abroad, he must not be molested until he has recovered from his fatigue, and become accustomed, in some degree, to his apartment and to those who are to attend to his wants. Above all, let it be seen to that his room is spacious, cheerful, and well-ventilated. If the weather be cold, the temperature must be regulated by the thermometer, uniformity in this respect being of paramount importance to the success of the enterprise. No operation of this kind should be undertaken in the heat of summer.

It is hardly necessary to state that no plastic operation should ever be attempted so long as the disease necessitating it is not completely eradicated from the part and system. It would be the height of folly, for example, to undertake the restoration of a nose lost in consequence of constitutional syphilis if there were any traces of this affection, in any portion of the body, however remote, or however distantly connected with the disfigured organ; for there could be no possible guarantee here that the disease might not attack the new nose or the adjoining parts of the old, and so frustrate the design of the surgeon. Besides, even supposing that such an untoward occurrence did not take place, still, it would be improper to operate, because the subjects of this disease are not only very prone to erysipelas but wounds in them generally unite with more difficulty than in healthy persons. The same remarks apply to struma, although I have great doubts whether this disease, by itself, ever destroyed any nose, ear, or lip. The mischief that is so often ascribed to it is nearly always done by syphilis, or by a combination of these affections from the transmission of the two poisons from the parent to the offspring. It is different with carcinoma. Here the plastic operation may, in general, be performed immediately after the excision of the specific disease.

The manner of performing the operation relates to the position of the patient, the surgeon, and the assistants; the administration of chloroform; the mode of selecting, making, and fastening the flaps; and several other circumstances which it is not necessary to specify.

If the operation be very simple, and likely to be soon over, the patient may sit up; otherwise he should lie down, his head and shoulders being properly supported by pillows. The surgeon and the assistants should dispose themselves in such a manner as may seem most useful for the prompt and successful execution of the operation. An anæsthetic is proper in almost every case, since the operation is frequently not only very tedious, but it is always desirable that the patient should be as passive as possible while it is in progress.

There are, as has already been stated, two points from which the integument may be transplanted for filling up the chasm in the mutilated organ; either from the immediate vicinity of the part, or from a distance. Thus, in making a new nose, or mending an old one, the flap may be taken from the forehead, according to the Indian method; or, if the gap be very small, even from the cheek, at a still shorter distance from the nose. Or the surgeon, adopting the plan of Taliacotius, now known as the Italian operation, may borrow the necessary material from the arm, although this method, owing to its tedious and complicated character, has become almost obsolete. In some cases the flap is obtained by a kind of migratory process, being successively transferred from one region to another until it reaches its final destination. Roux, in this manner, attempted to close an opening in the cheek, by inserting a piece of the lower lip into the upper, and, after a time, when the parts had contracted thorough adhesions and become accustomed to each other, transferring it to the place which it was intended permanently to occupy. Such a procedure would seem, at first sight, to be puerile, but upon reflection it will readily be seen that cases might arise where it would not only be justifiable but very proper.

However obtained, it is important that the integument should, if possible, be perfectly sound; free, not only from disease, but from scars. The importance of attention to this rule is too obvious to require comment. A cicatrice, having only a low vitality, is extremely apt to slough when transplanted. A sickly graft cannot take root on a sound bough, nor will a diseased bough permit the growth of a sound graft. To unite and maintain their future relations, both must be healthy. Another point of consequence is that the flap should be as destitute as possible of hair; for, although it might be divested of this after it has grown fast in its new position, yet it is always best not to incur any risk of unseemliness from this source.

The size of the flap must, as a general rule, be at least one-third larger than the opening which it is intended to cover, to allow for the necessary shrinkage. If the integument be very thick the contraction will be less than under opposite circumstances, but even here it is well for the surgeon to be on his guard, lest, when the cure is completed, the result should disappoint him. The shrinkage is always gradual, and generally continues for many months after the operation, the part gaining in thickness and density what it loses in circumference.

The shape of the flap must accurately correspond with that of the gap which it is destined to close. Hence the best plan is always to define its outline before the operation by means of a pattern, placed upon the surface whence the integument is to be taken, and marked off with ink, nitrate of silver, or, what is better than either, tincture of iodine.

The composition of the flap is a matter of importance. It should consist merely of skin and areolar tissue, with a small quantity of adipose substance; muscular fibre, nerves, and veins being carefully excluded. The presence of a thin layer of fat is always conducive to the preservation of the flap, as it tends to protect the subcutaneous vessels, and facilitate adhesion. A large pedicle must always be left, otherwise the part may die from inadequate supply of blood and nervous fluid. No large artery should be embraced in it, as this would convey more blood into it than would be required for its nutrition, or than the veins could return.

These preliminaries being disposed of, the surgeon is ready to begin the operation. With a sharp scalpel he now pares the edges of the part to be repaired, vivifying them with great accuracy, and removing all redundant and callous matter; or he may first dissect up the flap, and do the paring afterwards, as fancy or convenience may dictate. In executing this step of the operation, great care must be taken not to press or pinch, either with the finger or forceps, any portion of the flap or old skin, but to leave everything in as natural a condition as possible, since nothing will so readily promote reunion. The edges may be bevelled off or cut straight, according to circumstances, as will be more particularly described hereafter. The dissection is frequently attended with smart hemorrhage, but the rule is never to apply any ligature to the flap, lest it should interfere with the adhesive process, although any vessel that may spirt on the wound should at once be secured, and the wound itself promptly closed by suture. More or less gaping will of course remain, but it is astonishing how small a cicatrice is usually left even in the most extensive lesions of this description.

All bleeding having ceased, the flap is gently sponged, and accurately stitched to the edges of the chasm which it is designed to close. The most eligible suture will be found to be the interrupted, with an interval of from two to three lines between the threads, the ends being tied with a slip-knot over a narrow roll of adhesive plaster. The advantage of this procedure is that the suture may be loosened at any time if it be found to be too tight. Much harm is often done by placing the stitches too closely, the effect being to cut off the circulation. The twisted suture is objectionable for the reason, first, that the needles are, in many places, difficult of introduction, and, secondly, that they are liable to cause too great a degree of tension. The grooved suture, so happily used in plastic surgery by Professor Pancoast, will be described in connection with rhinoplasty, to which it is more particularly applicable.

The dressing is completed by covering the edges of the newly related parts with lint, spread with simple cerate, or wet with olive oil, in order to prevent them from becoming dry and shrivelled, an effect which is very liable to happen when this precaution is not duly attended to. The surface of the flap may be protected with dry lint, or, what is generally preferable, be exposed to the air. If it is very large, it will be necessary to confine it lightly in its place with adhesive plaster and a bandage, but anything like firm pressure must be carefully avoided. The wound from which the flap has been borrowed is dressed with cold water, and a similar application may be made to the amended organ if appearances indicate that there is a likelihood of overaction. The operation being completed, the part is kept at rest in a relaxed and elevated position; a light, cooling diet is enjoined; and the air of the apartment is carefully regulated by the thermometer, an equable temperature being of the greatest consequence to the welfare both of the part and system. A full anodyne is given the moment the patient is put to bed; but, if things go on well, the bowels must not be disturbed under forty-eight hours, when they may be opened by a cooling laxative.

The sutures may be removed, on an average, from the third to the fifth day; but so long as they are doing well they should not be disturbed, and there are few cases in which it is proper to take them all away at once. Great attention to cleanliness must be observed, and the best mode of effecting this is to irrigate the parts occasionally with the syringe.

If undue swelling and discoloration arise, the patient must be promptly bled and purged, and such local means employed as shall be best calculated to meet the emergency of the case. Leeches may be applied to the neighborhood of the flap, but not to the flap itself for fear of exciting erysipelas. Occasionally, a considerable flow of blood may be obtained by slightly lifting the flap at one or more points, the bleeding being encouraged with a sponge and warm water.

The great danger after an operation of this kind is erysipelas, which may be so considerable as to destroy not only the flap but also the patient. Such an occurrence should be promptly met by the topical use of dilute tincture of iodine, and by appropriate internal remedies, especially quinine and iron; aided, if there be any tendency to a typhoid state of the system, by stimulating drinks and a generous diet. Now and then a patient is lost by pyemia, but such an event is fortunately very uncommon. Gangrene of the flap, either from inadequate nutrition, over-action, or undue constriction, occasionally occurs, and destroys the success of the operation.

For a time the flap remains pale and cold, but these symptoms soon subside, and are succeeded by a bluish appearance and an increase of temperature. The circulation is evidently temporarily embarrassed, the arteries conveying blood faster to the part than the veins can remove it. Hence a certain degree of stagnation ensues, followed by a bluish, threatening condition of the part, which, however, soon disappears spontaneously. Natural sensation does not return for a long time; it begins first along the edges of the flap, and thence gradually extends over the rest of its surface. For the first few months the transplanted skin may appear unnaturally large and unseemly; gradually, however, it becomes smaller and smaller, and eventually may shrink so much as to answer but imperfectly the objects of the operation.

CHAPTER XVI.

SUBCUTANEOUS SURGERY.

SUBCUTANEOUS SURGERY is one of the creations of modern times, due chiefly to the genius and intrepidity of one man, Dr. Louis Stromeyer, of Hanover, who was the first to practise, upon a rational and philosophical plan, a subcutaneous operation, the undertaking consisting in the division of the tendo Achillis for the cure of club-foot. The operation was performed in February, 1831, and eventuated in the complete restoration of the use of the limb. Prior to this period several attempts had been made, by different surgeons, as Lorenz, Thilenius, Michaelis, Sartorius, and Delpech, to relieve this complaint, but they had all signally failed, simply because they had not been based upon correct scientific principles. The results of Dr. Stromeyer's observations and experiments were given to the profession in 1838, in a volume replete with interest, entitled Contributions to Operative Orthopædic Surgery, in which he has described, with circumstantial minuteness, the proper method of dividing the different tendons concerned in the production of the various distortions of the foot, with an account of the after-treatment.

Since the publication of Stromeyer, the domain of subcutaneous surgery has been greatly enlarged, by the application of its principles to other parts of the body, for the relief of which it has already performed the most valuable services. Dieffenbach, in 1839, gave it a new impulse by devising the operation for strabismus, which, although not practised by him subcutaneously, did much to inspire new confidence in the procedure, and to awaken a new interest in its application. Soon afterwards, however, the section of the muscles of the eye was performed without external wound, and the operation, originally suggested by Guérin, seems to be growing more and more in favor with the profession. The latter surgeon has extended the subcutaneous practice to the treatment of lateral curvature of the spine, by the division of the muscles of the back; and, at a more recent period still, it has been applied to the relief of numerous other affections, which would hardly admit of cure in any other manner. Among the more important operations which have grown out of this branch of surgery are the removal of cartilaginous bodies from the joints, the radical cure of hernia, the reduction of chronic dislocations, the evacuation of abscesses, the cure of anchylosis, and the obliteration of serous cavities. Too short a time has elapsed since the discovery of subcutaneous surgery to enable us to form a just estimate of its limits, or the extent to which it may with propriety be carried in practice; but it is not difficult to perceive that in a field affording such unbounded opportunities for the exhibition of display and selfishness, much abuse must creep in, which time alone will be able to rectify.

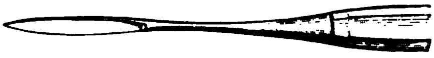
The practice of subcutaneous surgery is founded upon the great law that all wounds and injuries occurring without an opening in the integument unite with very little, or, according to some, with no inflammation, and with no suppuration, differing thus essentially from similar lesions accompanied with a solution of continuity of the skin, which are always followed by considerable inflammation, and also very frequently, if not generally, by a discharge of pus. This law, which is now universally recognized by surgeons, was clearly ennunciated by Mr. John Hunter, in his writings, near the close of the last century, but did not attract the serious attention of his countrymen until within a very recent period; not, indeed, until the facts of the subcutaneous section had been placed upon a firm and immutable basis by the practitioners of the continent of Europe. The idea of the illustrious Englishman lay in his writings, like a pebble upon the sea shore, often seen but never observed, until accident directed attention to it years after the establishment, by others, of the great principles which he had so clearly ennunciated. One reason, perhaps the chief one, of this was that he himself had never performed a subcutaneous operation: if he had, there is certainly no evidence of the fact in any of his writings. The only passage in his works which has any relevancy to the present subject is the following: "The injuries done to sound parts, I shall divide into two sorts, according to the effects of the accident. The first kind consists of those in which the injured parts do not communicate externally, as concussions of the whole body or of particular parts, strains, bruises, and simple fractures, either of bone or tendon, which form a large division. The second consists of those which have an external communication, comprehending wounds of all kinds, and compound fractures. Bruises which have destroyed the life of the part may be considered as a third division, partaking, at the beginning, of the nature of the first, but finally terminating like the second. The injuries of the first division, in which the parts do not communicate externally, seldom inflame, while those of the second commonly both inflame and suppurate." It is evident, from the tenor of this passage, that Mr. Hunter had carefully studied the influence of the air upon the effects of wounds, but it is not very clear, from aught that appears in it, that he had any conceptions whatever of the nature of subcutaneous surgery, properly so called.

Several of what are now dignified as subcutaneous operations have been performed for a long time. The mode of evacuating chronic abscesses by a valvular incision, first practised by Mr. Abernethy, early in the present century, legitimately belongs to this division of surgery, its object, as clearly ennunciated by the originator, being the exclusion of the air, it being well known that the contact of this fluid with the pus in the interior of the sac was the cause of the excessive local and constitutional disturbance which so often followed the old mode of opening these collections. Of the value of this procedure there can be no doubt, although the class of cases which it is intended to relieve is, from their very nature, unfortunately too often fatal. The operation of dividing the stricture in strangulated hernia, external to the sac, originated with J. L. Petit upwards of a century ago, but has only of late years received the attention it merits. Some of the English practitioners, commencing with Mr. Aston Key, have recently bestowed much attention upon the subject, and have adduced a body of testimony in its favor highly flattering to this mode of treatment. The object of the operation, whose advantages and disadvantages will be considered in their appropriate place, is, by relieving the bowel subcutaneously, to guard against the occurrence of the severe inflammation which so frequently attends the ordinary procedure, even in the hands of the best surgeons. The injection of hydrocele with irritating fluids, as suggested by Sir James Earle, early in the present century, is another instance of a subcutaneous operation, which has long been familiar to the profession, and been practised by every enlightened surgeon in Europe and America. Some recent writers have gone so far as to class the use of the seton in the treatment of ununited fracture among the expedients of subcutaneous surgery; such an application is certainly carrying this department altogether beyond its legitimate limits, and is therefore calculated to do the subject much harm by giving to it a wrong direction. The wound made by a seton is, to all intents and purposes, an open wound, followed not only by high inflammation but by profuse suppuration; occurrences which it is the peculiar province of subcutaneous surgery to guard against. A better example of a subcutaneous operation, performed for the relief of ununited fracture, is the division without wound, by means of a long, slender knife, of the soft tissues which form around the ends of the broken bone, the raw surfaces being afterwards approximated and maintained by appropriate apparatus.

On the whole, regarding subcutaneous surgery in its legitimate application, it appears to me that the cases to which it is adapted are susceptible of being arranged under the following heads: 1. Cases involving the division of tendons, muscles, and aponeuroses for the relief of various distortions, as club-foot, club-hand, spinal curvature, and strabismus; the reduction of dislocations, especially those of the foot; and the cure of anchylosis of the joints, depending upon contraction of the soft parts. 2. Operations for the radical cure of hernia, whether by puncture or injection; and division of the stricture in strangulated hernia external to the sac. 3. The evacuation of chronic abscesses and of purulent, serous, and sanguineous collections of the chest and other cavities, by a valve-like opening of the skin. 4. The withdrawal of cartilaginous concretions from the joints, as originally suggested by Goyrand and Syme. 5. Operations for obliterating serous cavities, when, in consequence of inflammation, they become occupied by serous fluid; as the vaginal tunic of the testicle, certain synovial burses, especially those about the hand and wrist, and various adventitious cysts, particularly those which are so liable to form in the neck in connection with the thyroid gland. 6. The comminution, by the knife, of diseased lymphatic ganglions, the incision of inflamed periosteum, and the division of morbid adhesions, as those existing in chronic luxations, in depressions of the nose, and similar affections. 7. Forced extension of anchylosed joints, rendered so by the formation of fibro-ligamentous bands. 8. The subcutaneous obliteration of nevi or vascular tumors, by ligature or injection. 9. The operation for the radical cure of varicocele.

The mode of operating for subcutaneous purposes must vary of course according to the particular indication which it is designed to fulfil. Whatever, however, the object may be, the rule is to make as small an external wound as possible, consisting, in fact, rather of a puncture than an incision, for it is ever to be borne in mind that one of the cardinal aims of every procedure of the kind is the exclusion of the air. The knife with which the operation is performed must therefore always be very narrow, sharp-pointed, and rather short, a length of edge from half an inch to an inch being a good average. The annexed sketch, fig. 155, represents the knife which I have long been in the habit of using in all my subcutaneous operations. Such an instrument is generally much more manageable than a longer one, while one of greater width would make too large an opening. If the object be to evacuate an abscess, a medium-sized trocar may be used, the skin having been previously divided with a bistoury. The instrument is then passed for a variable distance—usually from an inch to an inch and a half—through the subcutaneous cellular tissue, when its point is plunged into the pyogenic pouch, its entrance being denoted by the want of resistance and the escape perhaps of a few drops of thin pus. In extracting cartilaginous concretions from the joints, a delicate knife is carried along under the integument through the capsular ligament and synovial membrane, which are then divided to a sufficient extent to admit of the displacement of the morbid growth, previously fixed by the thumb and fingers, into the cellular substance external to the articulation, from which, after the wound is healed, it is removed by a

Fig. 155.



Tenotome.

secondary operation. The operation for the radical cure of hernia, requiring instruments of particular construction and use, will be described in its proper place, and so in regard to several other procedures which cannot be noticed here.

All operations of this kind should be performed with great gentleness and care; and whenever this is done there will be no risk either of severe inflammation, or of the division of any important vessels, nerves, or other structures not concerned in the particular affection for the relief of which the procedure is undertaken. I do not agree with those who maintain that tendons and other textures may be cut without the operation being followed by inflammation; on the contrary, I believe that a certain degree of incited action is present in every instance, and if this view of the case be correct it proves how important it is that it should be kept within proper limits. This subject, however, will again be adverted to in speaking of tenotomy. In general, the little puncture made in the operation unites in a few hours, while the gap which intervenes between the retracted ends of the divided structures is gradually filled up by plastic matter, which is eventually converted into analogous tissue.

Most subcutaneous operations are nearly bloodless, and this circumstance constitutes one of their great peculiarities. While open wounds always bleed to a greater or less extent, those made beneath the skin by a narrow, sharp-pointed knife, used with proper care, are almost free from hemorrhage. In dividing the tendo Achillis for club-foot, frequently not more than a few drops of blood are lost. As to shock, or serious depression of the nervous system, consequent upon such an operation, such an occurrence is never witnessed. The proceeding, however, is not always free from pain, especially during the efforts which are sometimes required to straighten the affected part after the division of the faulty structures; and hence it is often useful to administer an anæsthetic, the more so, because this not only prevents suffering, but, by rendering the patient passive, gives the surgeon a more complete control over his own movements.

Active preparatory treatment is rarely required in these operations. I have frequently performed the most extensive tenotomy at my clinic upon children whom I had seen for the first time only an hour before, and yet in no instance, so far as I have been able to learn, have any bad effects followed. The operations, however, for the radical cure of hernia, for breaking up adhesions in anchylosis, for the removal of cartilaginous bodies from the joints, and for the relief of some other affections, always demand more or less attention of this kind.

The after-treatment, for the first few days, is generally very simple. As soon as the operation is over, the little wound is covered with adhesive strips, to exclude the air, and the part, surrounded by a bandage, is maintained in a perfectly easy, quiet position. If active inflammation arise, which, however, will seldom be the case, the usual antiphlogistics must be employed. After nearly all of these operations suppuration must be prevented at all hazard.

When the operation has been practised for the relief of some deformity, as club-foot or spinal curvature, the cutting constitutes only a trivial part of the proceeding. The great care and trouble of the case come afterwards, in the fitting and wearing of the necessary apparatus. It is usually recommended that no apparatus should be used until after the lapse of several days, and this, as a general rule, will be found to be the best practice. I have, however, in many cases, so far deviated from this rule as to confine the affected limb at once, and usually without any disadvantage. Indeed, I have latterly thought that this ought to be the rule, and the delay the exception. As this subject, however, will have to be considered in connection with the various operations to which it relates, any further remarks upon it here would be out of place.

CHAPTER XVII.

AMPUTATIONS IN GENERAL.

SECT I.—INTRODUCTORY CONSIDERATIONS.

THE word amputation was formerly employed, and is occasionally even yet, to signify the removal of various kinds of tumors; thus, many of the older writers speak of amputation of the breast, amputation of the jaw, and amputation of the scrotum. At the present day, however, the term excision is generally used as more appropriate in connection with these procedures, while that of amputation is applied exclusively to operations for the removal of the limbs whether in their continuity or at their articulations.

I cannot agree with those who have denounced amputations as a disgrace to surgery; it is only when they are performed unnecessarily that they ought to be stigmatized by the profession and the public as an evil. Every pursuit is liable to abuse, to sins of omission and commission, and it would be strange if limbs were not occasionally cut off that might, under judicious management, have been saved. To denounce amputations, and to declare that they afford evidence only of the impotency and imperfection of our art, is to take a very narrow and erroneous view of the subject. It is not intended, as far as our own feeble powers of reflection enable us to comprehend the matter, that man should be able to cure every disease to which "flesh is heir." There are many maladies, as well as accidents, which are of necessity mortal; lesions which no human agency can repair or remedy. Who can save a limb that has been mangled and cut to pieces by the passage of a railway car, by the explosion of a steamboat boiler, by the fierce contact of a cannon ball, or by a fall from the top of a house down upon a heap of stones? Where is the surgeon that can prevent mortification from a burn that has charred the flesh, from a cold that has completely frozen the toes and feet, or from a malignant pustule that has inoculated all the tissues of an extremity? Is surgery to be held responsible because it cannot cure cancer of the bones, scrofula of the joints, and aneurism of the thigh and leg? So far from imputing blame to it in these and similar cases, we should be grateful for the assistance which it is capable of affording us as a means of relieving suffering and prolonging life. It is under such circumstances, in particular, that we can best appreciate its great and inestimable value. If it were not for the merciful interposition here of the knife, such cases would inevitably be doomed to a rapid and miserable death. Mortification would speedily do its work, the cancerous tumor would steadily spread and finally ulcerate, forming a frightful, disgusting, and painful mass of disease, and the scrofulous joint would soon wear out the system by hectic irritation. It is a sad thing to lose a limb, but it is also a sad thing to die; and what rational being, if he could have his choice, would not rather part with an extremity than with his life? No humane, enlightened, and conscientious surgeon will ever resort to amputation without being satisfied of its entire and perfect necessity; if he is young and inexperienced, he will be sure to avail himself of the best counsel within his reach, while, if he is thrown upon his own resources, he will not fail to give the case all the consideration and reflection that his own knowledge, wisdom, and judgment, may enable him to bring to his aid for the relief of the poor sufferer whom he is obliged to mutilate in order that he may rescue his life from the dangers which threaten him. I know of no operation which I approach with so much reluctance as the amputation of a limb, or one which gives me more real pain. To cut off an arm at the shoulder on account of an incipient cancerous affection of the head of the humerus, when the elbow, forearm, hand, and fingers are all perfectly natural and glowing with health, unconscious, so to speak, of the fate which awaits them, is enough to sicken the stoutest heart, and to discourage the boldest operator. If there be a more disagreeable task than this, I am ignorant of it; and yet I would not shrink from its performance even when there is but a faint prospect of prolonging life, if only for a few months. But the case is different, widely different, when the surgeon is called upon to amputate a limb crushed and lacerated by machinery; here there is no choice, no question concerning a cure by mere therapeutic measures; the knife is the only remedy, and the sooner it does its work the greater, as a general rule, will be the patient's chance of recovery. The body, it is true, is mutilated, perhaps sadly disfigured, but life is safe, and surgery, science, and humanity have achieved a real triumph. So long as there are accidents and diseases incurable by medical treatment, so long will there be a necessity for amputation, and happy is he who shall know when and how to perform it to the best advantage for his patient and the greatest credit to the art and science of surgery.

SECT. II.—CIRCUMSTANCES DEMANDING AMPUTATION.

The circumstances for which amputation may be required are not only numerous but extremely diversified in their character, and therefore deserving of the most careful consideration. They may be comprised under the following heads. 1. Mortification, however induced. 2. External injury, as wounds, fractures, and dislocations. 3. Morbid growths. 4. Aneurisms. 5. Diseases of the bones and joints. 6. Intractable ulcers. 7. Malformations and deformities. 8. Tetanus. The topics here enumerated comprise almost every kind of morbid action that can arise in the animal economy, and it will be perceived that they afford a wide and complicated field for the exercise of the talents and judgment of the surgeon. Space will not permit me to enter as fully into their details as might, perhaps, be desired; but I shall endeavor to advert briefly to the more important facts included under each head, having already called attention to some of them in the chapters on gangrene and wounds.

1. *Mortification.*—Mortification, in whatever manner induced, necessarily imperils limb and life, and therefore often becomes the subject of amputation. Hence the question arises, under what circumstances is a resort to the operation advisable and proper? This question can only be answered satisfactorily by a consideration of the nature of the mortification. In the chapter on mortification is an account of the several varieties of this affection, the causes under whose influence they take place, their symptoms, and the means required for their relief. By a reference to that portion of the work, it will be found that, as it respects the operation under notice, the great rule, recognized by nearly all surgeons at the present day, in acute gangrene, is, to wait for the formation of a line of demarcation between the dead and living parts, on the ground that it is not generally safe to interfere sooner, lest the disease should reappear upon the stump, and thus destroy the patient, or necessitate a repetition of the amputation. Of the propriety of this rule there can be no question, for there is no surgeon of experience who has not

witnessed its beneficial effects in his own practice, as well as in that of his friends, and yet it is equally true that it may occasionally be violated with great advantage. But I would apply to these cases the term "exceptional," comprising under this head those attacks of mortification which are so apt to supervene upon inflammation caused by external injury, as wounds, fractures, and dislocations, which often spread with immense rapidity, hopelessly overwhelming, if they be not promptly arrested, both the part and system in a few hours. It will not do for the surgeon, in such a case, to fold his arms and become an idle spectator; he must have his eyes and wits about him, or his patient is irretrievably lost; whatever is done must be done quickly. The wished-for line of demarcation will be looked for in vain; the gangrene will rapidly extend to the trunk, and death will soon close the scene. But in spontaneous mortification, or in mortification from erysipelas, carbuncle, and analogous affections, the judicious surgeon waits for the arrest of the morbid action, his chief care being to bring about this event as speedily as possible by appropriate local and constitutional measures. His rule of action is the same in hospital gangrene; in both cases means are employed for supporting the system, or, what is equivalent to the same thing, for improving the condition of the fluids and solids, and the knife is used only when the wished-for line of circumvallation is fully established, not a minute before.

In senile, chronic, or dry gangrene, the result usually of ossification of the arteries and of their occlusion by fibrinous concretions, thus depriving the tissues of their due supply of blood, the rule has heretofore been to wait for the cessation of the mortification, experience having shown that, when this precaution is neglected, the disease will be certain to reappear in the stump. It is in view of this liability in mortification to recur that some surgeons, of great eminence and experience, have given it as their judgment that the case should always be left entirely to nature's efforts; in other words, that we should wait for spontaneous amputation, shaping the stump after the dead parts have been nearly completely detached from the living, when, it is alleged, the part and system will be better prepared to withstand the shock of the interference. The propriety of such advice is sufficiently obvious when it is considered that this disease occurs nearly always in very old and infirm subjects, and that it is essentially dependent upon obstruction of the arteries leading to the affected parts. Such individuals, as I know from personal observation, are usually very feeble, and have consequently very little power of resisting the effect of shock caused by the use of the knife, and the loss even of a small quantity of blood. Hence it often happens that they sink soon after the operation, even when there has been a distinct line of demarcation, or that the disease speedily breaks out upon the stump, and soon destroys life secondarily. Seeing how common these events are, would it not be wise in the surgeon, the moment he is brought in contact with these cases, to amputate at a great distance from the disease, ere yet the vital powers have been seriously assailed by the morbid action; to remove, for instance, the thigh at its middle, for senile or chronic gangrene of the toes and foot? The only objection to such a procedure, it seems to me, would be where occlusion of the main artery of the limb reaches above the knee, a circumstance which would readily be determined by a careful previous examination. Where no such disease exists, and the general health has not yet materially suffered, I should not hesitate to resort to the expedient, under the conviction that, however severe, it was perfectly justifiable in a class of cases so unpromising as this confessedly is.

2. *Injuries.*—There are no lesions for which amputation is so frequently required as for wounds, fractures, and dislocations. Although they differ widely from each other in regard to the nature of the structures involved, these injuries may all be very properly classed under the same head, the more

especially as they often coexist, thus rendering it difficult to determine which of them is the most serious.

Of wounds, properly so called, the only ones which require to be considered in connection with the present subject, are the lacerated, contused, gunshot, and railway. Wounds inflicted by rabid animals occasionally, it is true, demand amputation, particularly when they extend deeply among the bones, as, for example, when they occur in the hands and feet; but even in such instances complete riddance can generally be easily effected by a careful excision of the bitten parts, and the cauterization of the raw surface after the cessation of the hemorrhage. I should certainly hesitate to cut off an arm or leg under such circumstances; with the knife and saw I should expect to accomplish all that was necessary, in any case, for the safety of the patient.

Lacerated wounds, as well as contused and gunshot wounds, of a most frightful, and, at first sight, apparently of the most desperate character, are sometimes recovered from in an extraordinarily short time, and with hardly any unpleasant symptoms. On the other hand, experience shows that the most insignificant injuries of this kind occasionally prove fatal in a manner and under circumstances which render it extremely difficult to account for the result. It would be a fortunate matter, both for the public and for the interests of science, if the surgeon could always form, if not a positive, at least an approximative estimate of the danger involved in each particular case of these wounds, for then it would be comparatively easy for him to adopt a suitable treatment for the relief of his patient; but, as it is, much must be left, in every instance, to the experience and judgment of the practitioner. In general, however, it may be observed that all such wounds are fraught with danger, both to limb and life, when they are attended with extensive laceration of the soft parts; when the muscles have been horribly bruised and pulpified, important nerves cut across, the principal arteries, or arteries and veins, torn open, large joints penetrated, and the bones broken in pieces. Under such circumstances there is not even a "forlorn hope," no matter what may have been the previous health and habits of the sufferer; the knife is required, and the sooner it is employed the better. Such cases are absolutely desperate, and no one who has any knowledge of consequences can hesitate as to the course to be pursued. Upon this point there is no discrepancy of opinion whatever among surgeons. But the injury may be of a less severe character, involving, perhaps, merely a considerable contusion of the soft structures with a compound fracture; or several muscles may be badly lacerated and the principal artery of a limb cut across; or a large nerve, the main trunk, it may be, be divided, and the interior of a large joint exposed. The case now assumes a more trying aspect; the responsibility falls upon the surgeon with tenfold force; for the question naturally, and at once arises, What shall be done? Shall such a limb be immediately amputated, or shall an attempt be made to preserve it? This is a question which will probably be asked by the patient himself, or by his friends for him, and which it is often extremely embarrassing and difficult to answer; in fact, it can only be answered upon general principles in one sense, and upon special principles in another. Looking at such injuries in a general manner, we might be inclined to give a favorable prognosis, because it is undoubtedly true that recovery from such lesions is by no means uncommon; but when we come to examine into the particulars of the case, we might not regard it in so auspicious a light. Thus, for example, the patient's antecedents may all have been bad, perhaps of the worst possible description; intemperance and dissipation of various kinds may have undermined his constitution, and thus rendered it unfit to bear up under an injury which he would formerly have supported without difficulty; or, instead of this, there may be serious structural disease of some vital organ, as the heart, stomach, or lungs, disqualifying him for enduring the accidental and now heavy burden. All these circumstances must have their weight with the practitioner when he is called upon to sit in judgment respecting the propriety or impropriety of an amputation. Conservative surgery may, and does do much, but it cannot do everything; it has its limits, beyond which it cannot safely go, and there are many points which require to be considered in order that it may do itself justice. A very severe injury, occurring in a stout youth, of healthy constitution and temperate habits, is often promptly recovered from, while less than one-third of its amount in a sickly, anemic, or dissipated person, will frequently destroy life in a few days, or, at all events, so far endanger it as to cause great anxiety for the result.

Gunshot, railroad, and steamboat accidents, and injuries occasioned by the caving in of stone quarries, are extremely liable, if an attempt be made to save the limb, to be followed by the worst results; and, what is particularly embarrassing in these cases, is the difficulty which the practitioner often encounters in ascertaining the precise amount of the lesion. The limb, perhaps, is entirely free from contusion and wound, or if there be any injury of this kind, it may be so slight as to be regarded as of no consequence. The mischief is deep-seated, and, upon careful examination, it will probably be found to involve nearly every important structure; muscle, tendon, aponeurosis, vessel, nerve, bone, and joint. Such cases obviously require the closest scrutiny with a view to the speedy detection of their true nature and their proper mode of management. Generally the limb is hopelessly injured, and will require removal.

Compound fractures and dislocations, and gunshot wounds of the joints, often require amputation, and yet it is remarkable how the parts and system sometimes bear up under such injuries, especially in young and healthy subjects. Under the improved methods of management of modern surgery recoveries occasionally occur, which, in former times, when their treatment was less perfectly understood than it is now, would have astonished the practitioner. In this country the treatment of compound fractures and dislocations by collodion, thereby converting these lesions into simple accidents, and of the former by extending and counter-extending bands of adhesive plaster, has greatly contributed to this result. The danger of these injuries is much greater, other things being equal, when they occur in the inferior extremity than when they occur in the arm and forearm, and in all cases the risk is much increased when they are accompanied by an open state of an important articulation, as that of the hip, knee, ankle, shoulder, elbow, or wrist. Compound fractures in the continuity of a limb, unless complicated with serious lesion of the soft structures, do not generally require amputation; if judiciously managed, they will usually get well without much trouble. Gunshot wounds, occurring in civil practice, are commonly less dangerous than injuries of this kind happening on the field of battle or on shipboard. I have seen enough of the former of these accidents to satisfy me that the patient will often recover with a very good limb, even when there has been extensive loss of substance and great comminution of the bones. In military practice, on the contrary, there will often be much difficulty in preserving the parts, simply because it is frequently impossible to treat the case properly on account of the want of suitable accommodations and a salubrious atmosphere. It is for these reasons that amputation is so often resorted to, during and after engagements, in cases which, if they took place under ordinary circumstances, would be successfully managed by milder means.

When amputation is determined upon, in these and similar accidents, the next question that arises is, when should the operation be executed? Shall it be performed immediately, or shall we wait until some time has elapsed, until the system has had an opportunity of recovering from the shock of the injury? To use the knife while the patient is in an exhausted, pallid, and perhaps almost pulseless condition, would only serve the more certainly and effectually to seal his fate; the additional shock to the constitution resulting from the loss of blood and nervous fluid could hardly fail to prove most disastrous. Hence the rule is always to postpone a resort to the knife until there is satisfactory evidence of reaction; until, in short, warmth and color return to the surface, the pulse beats vigorously at the wrist, and the sufferer regains, in some degree, his consciousness and courage. Now the use of chloroform is well borne, and the limb is removed with comparative impunity. On the other hand, care is taken not to defer the operation until the part and system are assailed by inflammation, which, as experience teaches, often extends with frightful rapidity under such circumstances, placing the case, perhaps, literally beyond the resources of surgery in the course of a few hours. There is, therefore, a time when interference must be avoided, not less than a time when it must be courted. The limits of these two periods are not always well defined, and hence much must be left, in each individual case, to the judgment of the attendant.

When amputation is performed immediately after reaction has taken place, it is usually designated by the prefix "primary," while the term "secondary" is used to denote the operation when it is executed after the limb has passed through the different stages of inflammation, an attempt having been made, perhaps well grounded, so far as the interpretation of the symptoms is concerned, to save the parts. Such a contingency must necessarily happen rather frequently, especially in civil practice; indeed, it is often altogether unavoidable on account of the obstacles interposed by the patient and his friends, not to say anything of the wavering and indecision of the professional attendant. But, although often unavoidable, such an occurrence is always much to be regretted; for if the chances of saving limb and life were bad in the first instance, they are now generally much worse; the system has been impaired by fever and perhaps hectic irritation, the secretions are seriously deranged, the patient has little appetite and sleep, the blood is thin and watery, and the whole body is much emaciated. Life may possibly still be preserved, but the probability is that the operation will be attended with much risk, and that ultimate recovery is far off. Moreover, a much larger amount of limb may now have to be sacrificed; originally a foot might have sufficed, whereas now, in consequence of the ravages of the inflammation, the whole leg may perhaps require removal. There is, then, obviously an advantage in a primary over a secondary amputation, provided it is performed at the proper time, that is, after the establishment of reaction and before the occurrence of inflammation; and this circumstance is often eagerly embraced by the military surgeon, whose will is always law with his patients.

3. *Morbid Growths.*—Amputation is sometimes required on account of morbid growths, or tumors, both benign and malignant. The removal of the forearm is perfectly proper for the cure of carcinoma of the hand, and of the arm at the shoulder for a similar affection of the humerus. No such operation is of course admissible if there is marked constitutional involvement, enlargement of the neighboring lymphatic ganglions, or decided tendency to ulceration; the propitious period has gone by, and interference would only hasten the fatal event. It is not so, however, as long as the general health remains good, and there is no evidence of general or local contamination; under such circumstances the probability is strong that removal of the limb, although it may not prevent a recurrence of the disease, will yet considerably prolong the patient's life.

A tumor, wholly divested of malignancy, may, in consequence of acting obstructingly, cause so much functional and other disturbance as to demand removal of the limb upon which it is situated. The procedure will be particularly called for when the morbid growth is intimately connected with a bone, or deeply and inseparably involved in the soft parts, or prolonged into an important joint, compelling free exposure of its surfaces during the operation. A valuable rule in tumors is to excise the benign, and to get rid of the malignant by amputation.

4. *Aneurism.*—Neglected aneurisms, seated in the extremities, and unamenable to ordinary treatment, occasionally call for the removal of the limb; in former times, such operations were sufficiently frequent when the disease occupied the popliteal region, though at present they are seldom, if ever, required, except when mortification sets in after ligation of the femoral artery, or in consequence of the injurious compression exerted by the tumor upon the leg.

5. *Affections of Bones and Joints.*—Various affections of the bones and joints, as caries, necrosis, morbid growths, aneurism, and anchylosis, may impose the necessity of amputation; and there is, according to my experience, no class of diseases in which the operation has been more frequently abused, or misapplied. There can be no question that many a limb, merely temporarily crippled by remediable disease, has been ruthlessly sacrificed to ignorance and a desire for eclat; carious joints, now that excision has been revived, can seldom demand so harsh a procedure, and as to necrosis, pure and uncomplicated, it is difficult to conceive of a case justifying the use of the knife. It is only, or mainly, in white swelling, or scrofulous disease of the knee, ankle, and elbow, attended with hectic irritation, excessive pain, and exhausting diarrhœa, that the removal of the limb can be proper, and even then it should not be thought of if it be possible to exsect the affected structures without imperilling life by shock and loss of blood. In whatever manner the offending parts are gotten rid of, it is surprising to witness the great improvement which usually follows the operation; the profuse sweats and alvine discharges rapidly disappear, the appetite improves, the sleep becomes refreshing, and the patient soon regains his flesh and strength. Unfortunately, the operation is generally put off to an unreasonable period, so that when it is at length performed, the sufferer too frequently sinks under its effects.

Of malignant growths of the bones almost the only one demanding amputation of the limbs is encephaloid; scirrhus, melanosis, and colloid are extremely infrequent in the osseous tissue, but whenever they occur, and their diagnosis can be determined, the same treatment must be applied to them as to medullary cancer; that is, early and thorough removal by the sacrifice of the suffering extremity, mere incision being always inadequate by reason of the involvement of the soft parts. Temporary relief only is aimed at; sooner or later the disease recurs, either at the cicatrice, or in some neighboring organ, and carries off the patient.

Fibrous, fibro-plastic, cartilaginous, and osseous growths, involving the bones, sometimes constitute a legitimate ground for amputation. An exostosis, of enormous size, and grotesque form, may render an extremity not only perfectly useless, but a source of the greatest inconvenience and even suffering. The so-called osteo-sarcomatous tumors are, perhaps, of all the morbid growths of the skeleton, the most common causes of amputation of the limbs. Aneurismal formations of the osseous tissue, met with chiefly in the head of the tibia, always demand the same remedy.

Finally, amputation may be required on account of anchylosis of a joint, interfering with the comfort and usefulness of the extremity. Thus, in anchylosis of the knee, the leg may stand off at a right angle with the thigh, so as to interfere materially with the occupation of the individual, and induce a wish for an artificial limb, which, if well constructed, is generally worn with great satisfaction. Stiff and crooked fingers and toes are often the subjects of amputation.

6. *Ulcers.*—Amputation is sometimes performed on account of old and inveterate ulcers of the extremities; the operation, however, is less frequently resorted to now than formerly, and might, with proper management, be almost entirely dispensed with. Unless the sore is of a cancerous character, or caused by burns, scalds, and frost-bites, or complicated with serious lesion of the bones, excessive enlargement of the veins, or great hypertrophy of the integuments, there are few cases, it seems to me, that will not gradually yield under judicious treatment. Of the numerous ulcers of the extremities that have fallen under my observation, embracing, of course, many of the worst description, I have a distinct recollection of only three that required this harsh measure. Whether other practitioners have been equally fortunate I am not able to state; but, judging from the reports of cases in our periodicals, it is highly probable that the operation is still not unfrequently performed on this account.

7. *Malformations.*—There are certain malformations and deformities for the relief of which amputation may be demanded. An irremediable club-foot, especially if complicated with a painful bunion, and intractable ulcer, or excessive atrophy of the leg, would form a proper subject for such an operation, for there are few men who would not rather run the risk attending its performance than to be incessantly fretted and worried by such a disagreeable and useless companion. Supernumerary thumbs and fingers are disposed of in the same manner; the operation is usually done within a few months after birth, and I have never known it to be followed by any bad consequences. Amputation is occasionally necessary on account of deformity caused by burns and scalds, or badly treated fractures and luxations.

8. *Tetanus.*—The propriety of amputating in tetanus has been so long doubted by many of the highest authorities in surgery that the question hardly merits serious consideration in a work of this kind. I have certainly not seen anything in my own practice tending to contradict an opinion now almost universally entertained by the profession in this and other countries. If such a measure is ever justifiable, it must be at the very commencement of the disease, before the supervention of the characteristic symptoms. I have seen a very considerable number of instances of acute traumatic tetanus, and, with one solitary exception, they have all proved fatal. This case occurred in a stout, well-fed countryman, aged fifty years, the fore and middle fingers of whose right hand had been badly mashed by the passage of the wheel of a wagon; symptoms of tetanus came on five weeks after the accident, and, although the disease had existed for five days when I amputated at the metacarpo-phalangeal articulation, yet complete recovery followed, not, however, without a slight continuance of the spasms for a short time after. I presume a practitioner would hesitate to cut off a large limb after the development of tetanus in any case; for, whatever notions we may entertain respecting the pathology of this affection, there can be no doubt that, once fully established, it must be looked upon as a constitutional disorder in the widest sense of that term.

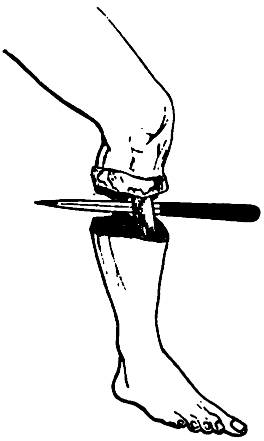
SECT. III.—METHODS OF AMPUTATION.

Two principal methods are in vogue for performing amputation of the limbs, whether in their continuity or at the joints. These are the circular and the flap, both of which, but especially the former, are of ancient date, and therefore well grounded in the esteem of the profession. To these was added, early in the present century, the oval operation, which, although excellent in its way, has hitherto received but little attention; certainly less than it deserves. Very recently, an operation, termed the rectangular, has been proposed. It is not my object to enter into the history of these different methods, for to do so would carry me back into the regions of doubt and speculation; but it will be expected that I should offer some remarks concerning their respective advantages and disadvantages, and this I shall endeavor to do in as concise and impartial a manner as may be consistent with the great interest and importance of the subject.

1. *Circular Method.*—The circular operation, the most ancient of all, was originally performed in the most simple manner, the integuments, muscles, and bones being all divided upon the same level. The consequence of this procedure was that the bones, being inadequately covered by the soft parts, or, rather, not covered at all, invariably perished to the distance of several inches, thus sadly protracting the cure, besides subjecting the patient to much suffering and not a little risk in the interval. As surgeons became more enlightened, they endeavored to provide against this contingency by forcibly pulling back the muscles, by means of a peculiar contrivance called a retractor, before using the saw, which was then applied close to the surface of the tissues. At a later period still, and as a decided improvement upon the preceding methods, arose the plan of double incision, devised by Cheselden, better known for his success as a lithotomist than for his exploits as a general operator. It consisted, as, indeed, the name sufficiently indicates, of two stages, in the first of which the integuments were cut and drawn back, while in the second the muscles were divided higher up, the object being to afford more thorough protection to the bone. The operation of the English surgeon has undergone various modifications, some of which, having only served to render it more complex, have been justly discarded from practice. To this category belong the division of the muscles by two circular incisions, one higher up than the other, and the plan of scooping out the parts as the knife was being swept obliquely around them by cutting from below upwards and from without inwards towards the bone, which thus formed the apex of the hollow cone.

The circular operation, as now generally practised, consists, first, in dividing the common integuments, dissecting them from the parts beneath, to a variable extent, and then drawing them back, or even turning them up like the cuff of a coat; secondly, in cutting through the muscles on a level with the retracted skin, and after detaching them for some distance from the bone, to hold them also forcibly back; and, thirdly, in sawing off the bone as high up as possible without doing violence to the soft structures. In executing these several stages of the proceeding the long amputating knife, poised lightly between the thumb and fingers, is carried rapidly round the limb, the point being inserted into its anterior surface, external to the median line, and thence drawn towards the operator in such a manner that the heel of the instrument shall finish the incision. The wound thus made extends simply down to the aponeurosis, and care should be taken that it occupies the same level throughout, unless there be special reasons for carrying it higher or lower at one point than at another, rendered necessary, it may be, by the presence of a vicious cicatrice, ulceration, gangrene, or some morbid growth. The flap is then rapidly dissected up either with the same instrument, or a large scalpel, and held out of the way, its length being

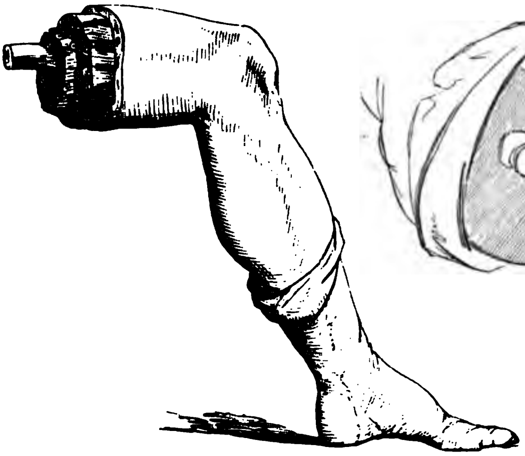
Fig. 156.



Circular amputations shown in the leg, the integuments being turned back, and the muscles divided down to the bones.

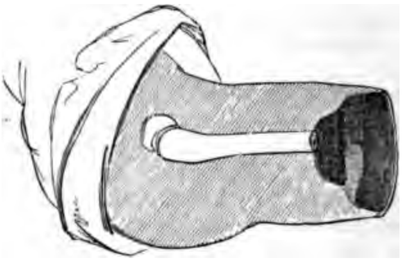
regulated by the thickness of the limb, about two inches being a good average. The amputating knife being now resumed, and held as before, is applied closely to the edge of the retracted integuments, and then drawn round the member so as to divide all the muscles down to the bone, as represented in fig. 156. This part of the operation is usually the work of a few seconds. The next step is to separate the muscles carefully from their connection to the bone, to the distance of at least an inch and a half, if not more, when, being pressed forcibly back by means of a retractor, the bone is sawed off close to their surface. The adjoining cuts, figs. 157 and 158, afford a good illustration of the appearances of the limb, both below and above the stump, after this operation.

Fig. 157.



Appearance of the limb below the seat of the amputation, in the circular operation.

Fig. 158.



Appearance of the stump in the circular amputation.

In sawing the bone, whether in this or in the flap operation, it is an object of primary importance to inflict as little injury as possible upon the periosteum; for the less the integrity of this membrane is disturbed the less likelihood will there be of necrosis and other bad consequences. When the periosteum is very thick, as in the thigh-bone, it would be well, in view of this circumstance, to make a circular track in it for the saw, in order that there may be no risk of laceration. The manner of dividing the bone is a matter of some moment. In most of the amputations that I have witnessed the instrument was applied against the front of the bone, instead of being held perpendicularly so as to divide the bone from side to side, as it generally should be to avoid fracture, which is so liable to happen if proper care be not taken to support the limb in this stage of the procedure. Particular rules are usually laid down by authors for working the saw. Thus, it is generally stated that the heel alone of the instrument should be used until a track is made for it to move in; but I consider all such directions to be unnecessary, if not frivolous. If the saw is properly set it is of little consequence, according to my experience, what part is applied first or last, or whether it be moved rapidly or slowly, although, as a matter of choice, I should prefer to finish the operation as quickly as possible. When there are two bones of equal size to be cut, as in amputations of the forearm, they should be divided simultaneously; but if one is thicker than the other, as in the leg, the weaker must always be separated first, lest, if it should remain until the other is sawed through, it should be broken or splintered, and so impose the necessity of employing the nippers to smooth off its extremity.

When a limb is removed at a joint, the best plan, as a general rule, is to dispense with the use of the saw and pliers altogether, experience having shown that the preservation of the articular cartilages greatly favors the adhesive process, and thereby expedites the cure. Sawing off the ends of the bones exposes the parts to suppuration, erysipelas, caries, necrosis, and even to the danger of pyemia.

2. *Flap Method.*—Although the flap operation was described, and no doubt practised, by some of the earlier surgeons, yet it does not seem to have received any particular attention until towards the close of the seventeenth century, when Lowdham, of Oxford, England, published a short tract upon it, setting forth its advantages over the circular method. After this period, it was occasionally performed in different parts of Europe, especially in France and England, but it never fully acquired the confidence of the profession until the time of Mr. Liston, whose teachings and writings brought it into general notice.

There are several methods of forming the flaps, the choice of which must be regulated by the particular circumstances of each individual case. Thus, the operation may be performed by transfixion of the limb, and cutting from within outwards, by commencing at the surface, and carrying the knife inwards towards the bone, or, lastly, by making one of the flaps after the former fashion, and the other after the latter. In amputations of the thigh and arm, it is customary to make both flaps by transfixion, as the operation is thus greatly simplified and rendered more expeditious; but in the forearm, hand, fingers, leg, foot, and toes, they are formed either by cutting inwards, or one by cutting inwards and the other by cutting outwards. The number of flaps varies; in general there are two, but occasionally there is only one, and, on the other hand, there may be as many as three; accident, or the situation and structure of the limb, rendering one of these modes preferable to the other. Thus, in one instance, I amputated the thigh at its middle by a solitary flap, and succeeded in effecting an excellent cure. The military surgeon is often compelled to form his flaps as best he can, owing to the manner in which the soft parts are injured, and in civil practice the same difficulty sometimes occurs in consequence of the effects of disease. Whatever may be the nature of the case, the rule is never to include any unsound tissues or any portion of bone that is fractured or divested of periosteum. In amputating the thigh and arm at their middle, the flaps are generally cut of the same length; but in most other situations one is usually made considerably longer than the other, depending upon the greater amount of muscular substance. Their relative length must be regulated by the thickness of the limb, and the quantity, laxity, and contractility of the soft parts. It is better, in every case, to have too much substance than too little, but the judicious surgeon will always endeavor so to cut his flaps as to have just enough, and no more, to form a well-shaped and useful stump, redundancy being always unseemly, if not actually in the way of comfort and convenience. As a general rule, their length should equal about three-fourths of the diameter of the limb, being invariably greater than in a similar operation upon the dead subject, to allow for contraction and shrinkage. The form of the body of the flaps is commonly somewhat convex, while the extremity is more or less oblique, care being taken that they do not terminate in thin, narrow ends, and that there is always an abundance of integument after they are adjusted over the bone. When the muscular tissue is unusually abundant, as often happens in amputating through the calf of the leg, I have found it advisable to retrench it with the knife, in order to give the stump a more seemly shape, as well as to place it in a better condition for bearing the pressure of an artificial limb.

This book is the
COOPER MEDICAL
SAN FRANCISCO,

In performing the operation the same general rules are to be observed as in the circular method; hemorrhage is restrained by the same means, and the skin is drawn back by the hands of an assistant, who also retracts the flaps as one after the other is made, and thus holds them out of the way of the knife and saw. Any important vessels that may be bleeding are instantly compressed by the fingers until they can be tied. Before applying the saw the knife is pressed closely around the bone so as to divide every muscular fibre, and also, if possible, the periosteum. The most suitable instrument for removing the larger limbs is a long amputating knife; for the smaller ones, an ordinary scalpel, bistoury, or catlin will answer best. Separation of the member having been effected, and the vessels carefully secured, the next thing to be done is to cut off the principal nervous trunks a little above the level of the surface of the stump, and, as the operation is one of excessive pain, it should always be performed before the patient has fully recovered from the influence of chloroform. I need not dwell upon the importance of thus dealing with the nerves involved in the flaps; the necessity of the procedure must be obvious upon the slightest reflection. When it is considered that they always become more or less enlarged and bulbous after all operations of this kind, it is easy to perceive what would be the consequence if they were brought in contact, as some of them almost inevitably would be, with the extremity of the bone, before it has had time to become rounded off. I regard no amputation by the flap method as being finished unless provision has been made against such a contingency. The adjoining cuts, figs. 159 and 160, represent the appearances of the stump and of the limb after its removal.

Fig. 159.

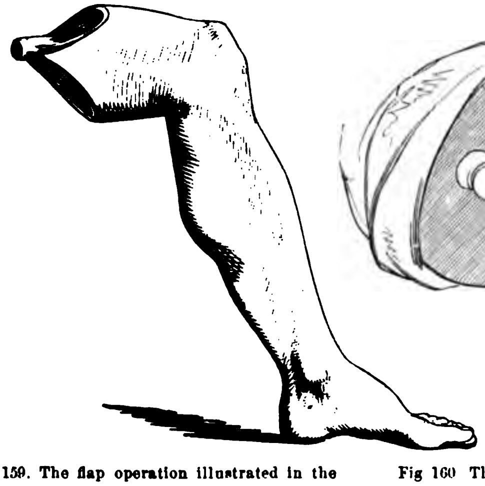


Fig. 159. The flap operation illustrated in the thigh. The sloping wounds, whence the flaps have been taken, shown in the amputated part.

Fig. 160.

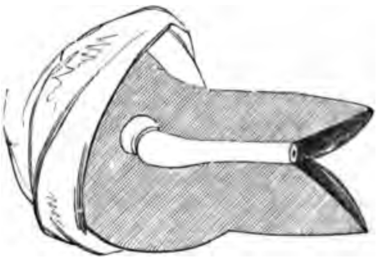


Fig 160 The corresponding stump; intended to exhibit the comparatively small extent of wound that remains.

3. *Oval Method.*—In the oval method, as it is termed by Scoutetten, by whom it has been generalized, or the oblique process, as it has been called by others, the wound has somewhat of the shape of an ovoid, the small extremity of which corresponds to the bone or joint which is the seat of the amputation. The operation holds a kind of intermediate position between the other two, resembling the circular process in the mode of incising the soft parts, and the flap in the form of the wound. It is more especially

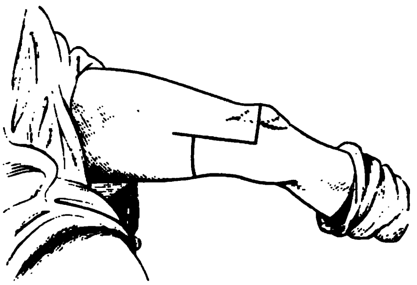
adapted to amputations of the joints, particularly the smaller, as, for example, the metacarpo-phalangeal, but has also been applied to the joints of the hip and shoulder, especially by Guthrie, Larrey, and Scoutetten, who have devised plans which severally bear their names.

In the oval operation the flaps are formed by cutting from without inwards, or one is formed in this way and the other by cutting in the opposite direction, or from within outwards. It is commenced by making two incisions in the shape of the letter V reversed, the angle of union falling a little above the place where it is intended to saw the bone or effect disarticulation. These incisions are, of course, extended as far as the periosteum, when the knife, drawn closely round behind the bone, is carried downwards on a level with the termination of the two cuts already made, thus connecting them by one thrust, as the instrument sweeps through the intervening tissues. By adopting this plan of procedure the surgeon will have it in his power to leave the principal vessels and nerves until the operation is nearly completed, a circumstance which thus affords him a much better control over the hemorrhage.

The oval operation usually makes an excellent stump, there being always an abundance of material for covering the bone; it is generally a little more tedious than the flap amputation, but this should not be urged as an objection to it, as in all other respects the result is most satisfactory.

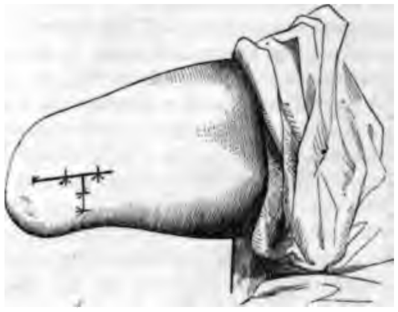
4. *Rectangular Flap.*—Mr. Teale, of Leeds, has recently modified the double flap operation by substituting a long and a short rectangular flap. The long flap should be made from the portion of the limb which does not contain important bloodvessels and nerves, these being included in the short one. Before proceeding to the operation, the lines of the incision should be traced with ink, in order to insure the proper dimensions of the large flap, which should be equal, in its length and breadth, to one-half the circumference of the limb at the point amputated. The short flap, which should be made last, should be one-fourth the length of the long one. The lines of incision and the length of the flaps will be more easily understood from the annexed cut, fig. 161, representing an amputation of the thigh. The parts having been dissected off, in close contact with the periosteum, the long flap will be found to be perfectly square, and to contain a sufficient amount of movable soft parts to form a complete cushion for the end of the bone, which must be sawn off perfectly straight, and must be free from spicules, in order to prevent ulceration of the soft structures. The arteries having been taken up, the long flap is brought down over the end of the bone, and attached to the short one by several points of the interrupted suture. The short flap is also attached to the long flap laterally, as

Fig. 161.



Teale's amputation, shown in the thigh, the lines indicating the size and form of the flaps.

Fig. 162.



Teale's operation, the flaps being drawn together.

is also the reflected portion of the long flap to its unreflected portion. The appearances of the parts, when brought together, are shown in fig. 162.

Beside the sutures no other dressings are employed. The stump is placed on a pillow covered with a sheet of gutta-percha, and is protected by a wire cage from the pressure of the bedclothes. Should the wound gape during the process of union, a few adhesive strips may be applied, to give the flaps proper support. Absolute rest is enjoined; and the stump should not be disturbed, the discharges being removed from the parts and the gutta-percha cloth by a soft sponge.

Mr. Teale publishes a summary of fifty-six cases treated by his method during the last three years. Of these, the whole number of deaths was seven, or in the proportion of one to eight. Eighteen operations were performed on the thigh, twenty-eight on the leg, six on the arm, and four on the forearm. Of this whole number, only six cases were of traumatic origin, and of these but one resulted in death. This shows a great contrast with seventeen traumatic operations at the Leeds General Infirmary, by the same surgeons, of which ten died, seven from the effects of purulent infection. Amputation of the thigh for disease by this method exhibits a mortality of nearly one case in six, whilst in the London hospitals it is as one in four and a half, and in the provincial hospitals, as one in four.

The rate of mortality in amputations of the leg for disease is one in twenty-seven. In the London hospitals it is one in three and two-thirds, and in the provincial hospitals one in four. Mr. Teale, after carefully analyzing 640 amputations of the thigh and leg, for disease or injury, performed by the ordinary methods in the London and provincial hospitals, found the mortality to be nearly one in three. In forty-six amputations of the thigh and leg by the rectangular flap, for injury or disease, the fatality is one in fourteen, showing a most striking contrast with the above facts.

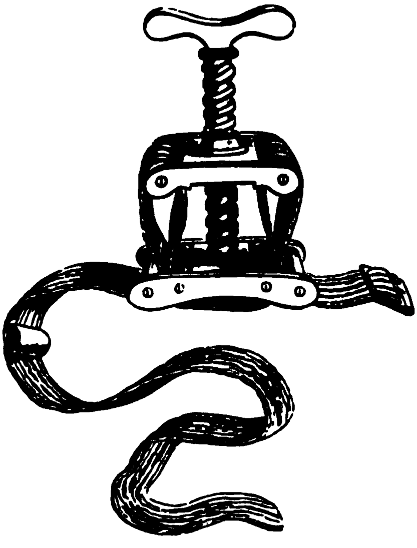
SECT. IV.—OPERATION AND AFTER-TREATMENT.

The position of the patient and the surgeon, the number and duties of the assistants, and the character of the instruments, must necessarily vary in different cases and under different circumstances, and can therefore be pointed out here only in a general manner.

Whenever it is practicable, the patient should be placed recumbent, as he will thus be much less liable to become faint, and at the same time bear the effects of chloroform much better than when he sits up. He may, however, put himself in the latter position without any inconvenience during the amputation of a finger or toe, or even of the arm or leg, if he is courageous, and willing to dispense with chloroform, or to take ether in its stead. The limb is generally held horizontally, away from the table, one assistant retracting the integuments, and another supporting the portion to be removed. A third assistant takes charge of the tourniquet, but before applying it care is taken to empty the superficial veins by raising the limb and pressing it from above downwards: or, instead of this, the extremity is tightly bandaged just before the operation. Such a precaution, however, is only of material moment when the patient is very feeble, and therefore ill able to bear the loss of blood. Chloroform having been administered, the instrument is firmly secured round the limb, the frame resting upon a thick, narrow compress, lying directly over the main artery, and, when all pulsation is arrested, the operation is proceeded with in as rapid, orderly, and careful a manner as possible. When the amputation is performed high up near the trunk, the tourniquet may advantageously be replaced by the compression of the hands of an assistant, who trusts either to his thumbs alone, or else makes the requisite pressure by means of the handle of a stout key, wrapped round with a piece of muslin. The same plan for restraining hemorrhage is adopted in amputating at the hip and shoulder-joints. In separating a large limb, not less than five assistants are generally necessary; one for administering chloroform, a second to take charge of the tourniquet, a third to hold up the flaps, one to support the distal portion of the member, and a fifth to hand the instruments and sponges, and aid in securing the arteries. A small number will of course suffice when we remove a finger or other insignificant part.

The different methods of amputation are described in the preceding section. The one which I prefer is that by flap, though it cannot be denied that a most excellent stump may be made by the circular operation. The rectangular method I have never performed, but it seems to me to be a procedure well worthy of attention, as the arrangement of the long flap not only thoroughly protects the bone, but, what is a matter of great consequence, admits of ready drainage. The oval operation is admirably adapted to amputations at the joints and to resections of the bones.

Fig. 163.

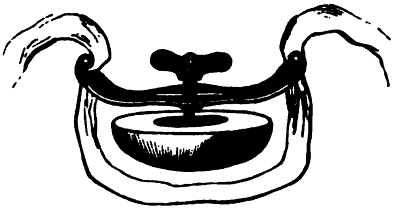


Petit's tourniquet.

My reasons for preferring the flap to the circular operation, are, first, because it is more simple and easy of execution; secondly, because it makes, as a general rule, a much better covering for the bone, and, lastly, because the patient experiences much greater comfort in wearing an artificial limb. Mr. Palmer, who has for many years been engaged in the manufacture of artificial legs, assures me that stumps made by the circular operation seldom answer well for the adaptation of an artificial substitute.

The principal instruments required for the operation are, for the larger limbs, a tourniquet, an amputating knife, a catlin, saw, and pliers, which are properly arranged upon a tray in the order in which they will be needed. For removing the fingers, hand, toes, and foot, an ordinary scalpel will commonly suffice. The tourniquet in general use is that of Petit, the construction and arrangement of which may be readily learned from the annexed sketch, fig. 163, a circumstance which, besides the fact that it is found in every cutler's shop, will render any formal description of it unnecessary.

Fig. 164.

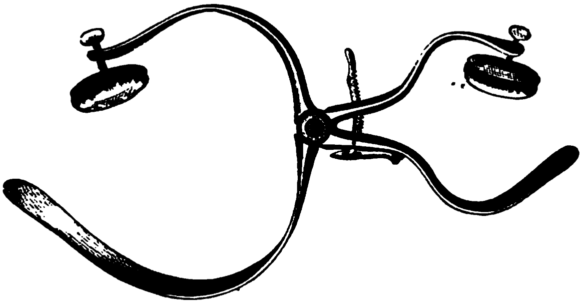


Tiemann's improved tourniquet.

The tourniquet of Petit was recently modified by Mr. Tiemann, of New York, in such a manner as to concentrate a much greater amount of pressure upon the artery, at the same time that it does not embarrass the venous circulation. The pad is placed either horizontally or crosswise upon the vessel, and the strap, carried round the limb, is passed through the two side apertures in the metallic plate, after which the ends are drawn very tight, and fastened on the protruding hooks. The arrangement of the different pieces of the instrument is seen in fig. 164.

Fig. 165 represents an arterial *compressor* which I devised several years ago, as a convenient substitute for the ordinary tourniquet, over which, I conceive, it possesses several decided advantages; first, in the facility of its application; secondly, in the amount of pressure which it is capable of exerting; thirdly, in its ready adaptation to limbs of different dimensions; fourthly, in the circumstance that it makes pressure only at two points, that is, over the artery, and at the spot immediately opposite to the artery; and, lastly, the facility with which it may be slackened or removed at any stage of the operation. With a little modification, the instrument may readily be adapted to the femoral artery as it emerges from beneath Poupart's ligament, or even to the external iliac just above this ligament, in amputation at the hip-joint, and also to the axillary artery, in disarticulation of the shoulder-joint.

Fig. 165.

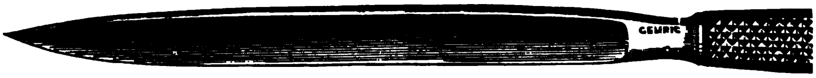


Author's artery compressor.

By a reference to the cut, it will be seen that the instrument is composed of two blades, differing in the degree of their curvatures, united by a screw, and regulated by a rachet. Each short blade is provided with a pad, capable of being worked by a screw, and designed to rest upon the artery which it is intended to compress. By this arrangement two tourniquets are produced: a large one for the thigh, and a small one for the arm, or the thigh of a small subject.

The ordinary amputating knife, seen in fig. 166, is from nine to twelve inches in length, by about five lines in width, with a moderately thick back, spear-pointed, and furnished with a stout, rough, ebony handle to prevent it from dropping out of the hand if it should become smeared with blood. The principal edge should extend the whole length of the blade, and be in the best possible condition for executing its important office, well tempered, and perfectly sharp. The edge upon the back should not be longer than an inch and a half. With such an instrument properly managed, nearly all the amputations in the body may be performed with great neatness and despatch.

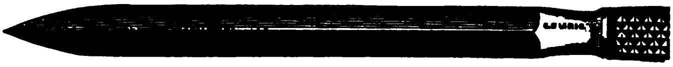
Fig. 166.



Amputating knife.

The catlin, shown in fig. 167, is a double-edged knife, used principally in removing the forearm and leg, and for dividing the interosseous muscles and ligaments; I cannot see, however, that it possesses any special advantage, even in these cases, over the larger knife just described.

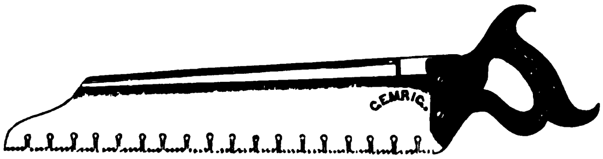
Fig. 167.



Catlin, or double-edged knife.

Every amputating case contains a large saw, resembling the common dove-tail saw of the cabinet-maker. The adjoining sketch, fig. 168, represents the form of the instrument which I am myself in the habit of using. The blade, which is very firm, is ten inches and a half in length at the cutting edge, by two inches and one eighth in breadth, exclusive of the back, which is very thick and convex, in order to afford the proper degree of strength which such an implement should always possess. The handle is rough, and sufficiently large to receive two fingers, while the thumb and forefinger are applied to its surfaces, parallel with the upper border, to keep it steady while engaged in the discharge of its duty. The teeth are rather large but sharp, set crossways on the edge, that the instrument may not hang or hitch as it works its way through the bone. The manner of using the saw has already been described.

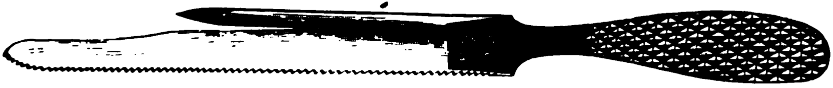
Fig. 168.



Amputating saw.

A small saw, such as is represented in fig. 169, will be of great service in amputations of the hand and foot.

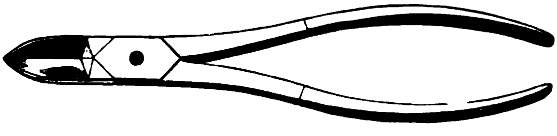
Fig. 169.



Small amputating saw.

Cutting-pliers, seen in fig. 170, of various sizes and forms, must be at hand; they should be short but rather slender in the blades, and very long and strong in the handle. Although I never use these instruments when it is possible to employ the saw, on account of their tendency to bruise the

Fig. 170.



Bone nippers.

osseous tissue, yet they are of great convenience for removing sharp spicula, and cutting off certain pieces of the skeleton, as the phalanges of the toes and fingers, the ribs, and jaws.

As it respects the permanent *dressings* after amputation, they should be of the lightest and most simple character. In the larger operations they should not, as a general rule, be applied before the lapse of four or five hours, by which time the surfaces of the wound will usually be glazed with lymph, and all danger of hemorrhage be past. I can conceive of nothing more awkward for the surgeon or disagreeable to the patient, than the necessity of undoing the dressings, some hours after the removal of a limb, for the purpose of searching for bleeding vessels. Such a procedure is sure to cause alarm and suffering; and, although it is always desirable to complete the dressings as early as possible in ordinary cases, yet after a large amputation, involving vast and numerous muscles liable to conceal arteries of considerable size, I regard it as a matter of great consequence not to hazard the necessity of their removal. During the period that intervenes between the operation and the permanent dressings, the limb should be placed in an easy and elevated position, and the flaps should either be loosely approximated with a few adhesive strips, or, what is better, left apart, and covered with light compresses wet with cold water, and frequently irrigated; not changed, unless soaked with blood, as this would only lead to exposure and irritation of the parts.

All bleeding and danger of bleeding having ceased, the flaps are carefully stitched in place, the ligatures are brought out at the nearest points, and the intervals between the sutures are covered with long and rather narrow strips of plaster, to admit of sufficient drainage. This should be still further favored, when the breach is very large and deep, by the insertion of a slender tent in the lower angle of the wound, and strict attention to the position of the stump. To a want of these precautions are unquestionably to be ascribed some of the bad effects of these operations, as pyemia, profuse suppuration, and the death of the extremity of the bone. The wound being firmly closed at all points, the matter, of which there is nearly always more or less after all large amputations, accumulates in the depths of the stump, around the bone, and among the muscles, thus causing necrosis of the former, and affording the veins and lymphatics of the latter an opportunity of conveying the fluid into the system, and thereby inducing secondary abscesses. Now, all this risk may be effectually prevented by adopting the plan here suggested of keeping a long, slender, and well-oiled tent in the lower part of the wound for the first thirty-six or forty-eight hours; at the end of this time it may be carefully removed, and any pus that may be present gently pressed out. A gum-elastic tube may now, if necessary, take the place of the tent, with a view to a more ready and steady drainage; or, if the suppurative crisis is passed, the foreign body may be dispensed with, and the case managed in the ordinary way.

The adhesive strips must, if possible, extend four or five inches beyond the upper extremity of each flap, especially in the larger amputations, so as to prevent the retraction of the integuments; and for the purpose also of quieting the muscles and bringing them well forward over the bone. I have been in the habit for many years of beginning the application of the roller at the part of the limb nearest the trunk, carrying it firmly and equably downward to the very verge of the stump, which is then enveloped by a few crucial turns of the bandage, to give it greater support. No other dressing is necessary. The limb is now placed in an easy and slightly elevated position, over a sheet of gutta-percha, and kept constantly wet with cold water, applied by means of a light porous napkin, substitution being employed only in the event of the cloth becoming bloody or offensive. If suppuration be threatened, or the cold is disagreeable and chilling in its effects, the most eligible remedy will be an emollient cataplasm or the warm water-dressing. Provision is of course made to protect the stump from the contact of the bedclothes. As soon as the operation is over, a full anodyne is ordered, for the twofold purpose of relieving pain and preventing spasm; and the dose is afterwards repeated from time to time as circumstances may seem to demand its exhibition. The diet should be light but rather nourishing than otherwise; and, with the exception of a mild aperient on the second day, no medicine whatever should be given unless it is absolutely necessary on account of the violence of the traumatic fever, or the danger of exhaustion from shock and hemorrhage. When the system is much depressed at the time of the operation, it will be well, as a general rule, to put the patient at once upon a generous diet, and perhaps even upon the use of milk punch. I am satisfied, from what I have seen of these cases, that the worst possible plan that can be pursued is starvation; this not only weakens the system still farther but tends powerfully to the production of pyemia and typhoid fever.

The dressings may require removal within forty-eight hours after the operation, or not under three or four days, according to the condition of the parts. When the adhesive action is progressing favorably, the less interference there is the better; any discharge that may collect upon the surface of the stump may be easily soaked up with a soft sponge. If considerable swelling and pain take place, or profuse suppuration set in, the change cannot be effected too soon; and it need hardly be added, that, while it is being made, the stump should be well supported by an assistant, and that all pressure and unnecessary manipulation should be avoided. Any tendency to bagging that may show itself is to be counteracted by the judicious application of the adhesive strips and bandage. The sutures should not be cut out too soon; as long as they are affording support they should be permitted to remain.

After the wound has healed, the stump should be protected for some time with a piece of soft flannel, to prevent the ill effects that might otherwise arise from atmospheric vicissitudes; and all pressure upon its surface should be carefully avoided until the parts have regained their natural sensibility.

SYNCHRONOUS AMPUTATION.

In cases of accident, as well as in certain diseases, but especially in the former, it occasionally becomes necessary to amputate two limbs simultaneously, or in immediate succession, the circumstances which call for the removal of the one demanding the separation of the other. This constitutes what is termed the synchronous double operation. It is founded upon the assumption that the recovery is more rapid when two limbs are cut off simultaneously than at two separate and distinct periods; that the loss of blood will be comparatively little more from two amputations thus performed than from one alone; that there will be, in the aggregate, much less pain, shock, and inconvenience; and, lastly, that the patient will thus escape the harassing anxiety of mind growing out of the knowledge that he will be obliged to submit to another operation. Synchronous double amputation has occasionally been performed in various parts of this country and Europe; but so far as my information extends it was first adopted, as a rule of practice, by the surgeons of the Hôtel-Dieu, at Quebec, the first case having occurred, many years ago, in the hands of Dr. Morris, of that city. Within the last ten years the operation has also been performed several times by Dr. Carnochan, of New York. But the most remarkable instance of the kind of which I have any knowledge, occurred in 1847, at Schuylkill Haven, Pennsylvania, in the hands of Dr. John G. Koehler, who removed simultaneously, on account of a railroad injury, both legs and one arm from a lad, aged thirteen years, recovery taking place without the supervention of any serious symptoms. The limbs were frightfully crushed, and the operation was performed within a short time after the accident. The arm being removed first, the pulse immediately sank, but under the influence of stimulants it rose sufficiently in five minutes to justify amputation of both legs below the knee. So excessive had been the shock of the system that the boy hardly experienced any pain during the operation.

The synchronous double operation may be performed by two surgeons, or by one alone, the latter being perhaps the preferable method. In either event, it is a matter of paramount importance to protect the patient from the loss of blood, the slightest effusion of which might prove prejudicial to his safety. Dr. Carnochan is in the habit of cutting off both limbs before he ties any vessels, and this is undoubtedly the preferable plan if we can be certain of having perfect control over the hemorrhage, as we may be if we have proper assistants, and the removal is effected rapidly by the flap operation.

SECT. V.—AFFECTIONS OF THE STUMP.

These affections are either of a primary or consecutive character, and both may be purely of a local, or of a local and constitutional origin. The primary consists of hemorrhage, spasm of the muscles, excessive pain, undue inflammation, osteomyelitis, and inordinate retraction of the soft parts, thereby permitting exposure of the bone. Among the secondary effects may be mentioned necrosis and exfoliation of the bone, degeneration of the nerves and neuralgic pain, aneurismal enlargement of the vessels, and contraction of the tendons in the neighborhood of the stump, by which the latter is drawn out of its proper position, and so made a source of inconvenience and discomfort.

1. PRIMARY AFFECTIONS.

a. Hemorrhage may come on soon after the dressing of the stump, or not until some time has elapsed; perhaps not for several days. It is usually occasioned by the want of a sufficient number of ligatures, in consequence of the retraction of some of the smaller arteries, thereby escaping the surgeon's attention while he is looking out for the principal and more accessible branches; or it may be that the vessel has been cut obliquely, and that it has not been tied high enough up; or, finally, that the arterial tunics are so much diseased as to give way under the pressure of the cord before the formation of an adequate internal clot, as when the bleeding supervenes several days after the operation. However induced, or whatever may be the circumstances which give rise to the hemorrhage, the proper remedy consists in exposing the open artery, and securing it with the ligature, either by separating the flaps, or, if adhesion is already far advanced by dilating the canal along which the blood flows over a grooved director. The main artery of the limb is not tied unless it be found impossible, on account of disease, or some other cause, to make the application of the ligature at the stump.

Sometimes the hemorrhage is purely venous, the blood flowing away lazily, in a dark purple stream, without any jet; and when this is the case it will generally be found to depend upon the want of accurate coaptation of the flaps, or some defective application in the bandage, making either too little or too much pressure; in the former case enabling the vessels to remain open and gaping, and in the latter interfering with the passage of their contents. Occasionally the blood oozes out at different points, as water oozes out of a sponge, and this may take place either from the soft parts, or from the Haversian canals of the bones, or from the medullary membrane and the marrow. Arrest of the bleeding is usually effected simply by compression of the stump, the compress and roller being made to bear steadily against the offending vessels, aided by elevation and cold applications; when this fails, the ligature may be required, or, what is preferable, because altogether free from the danger of phlebitis, constriction of the vein by inclusion in the surrounding tissues. For this purpose, after being carefully dissected from its attachments, it is transfixed by a curved needle, armed with a small double cord, and drawn through an opening made for it in one of the adjoining muscles. Both ends of the cord are then brought out at the nearest angle of the wound, and retained for twenty-four hours, or removed at once, if there be no probability that the vessel will lose its hold. When the vein has been cut off unusually high up, so as not to admit of this procedure, I never hesitate to tie it, even if it be one of large size, such, for instance, as the femoral, although the operation should always, if possible, be avoided for the reason just stated. When the blood proceeds from the Haversian canals it will generally be necessary to undo the flaps, and apply a compress directly to the surface of the bone, the wound being kept open until the flow is arrested. Caustic applications must not be used for fear of causing necrosis.

b. Spasm of the muscles, which is frequently a source of great distress, and which presents itself in the form of jerks or twitchings, usually sets in within a few hours after the operation, and is generally most severe in persons of a nervous, irritable temperament. No patient, however, is ever entirely exempt from it after amputation, and it is always sure to be materially aggravated on the occurrence of inflammation. In regard to treatment much is to be done in the way of prophylaxis; by the judicious use of the roller to give equable support to the muscles of the stump, together with elevation of the part to favor venous return, and also by the early exhibition of a full anodyne. The use of morphia, or of morphia and antimony, along with warm fomentations, will be required if the spasm is at all severe when no such precautionary measures have been adopted.

c. The degree and continuance of the *pain* which follows an amputation will be influenced very materially by the character of the case, the size of the limb, the presence or absence of complications, and, above all, by the temperament of the patient. Coming on usually as the system emerges from the influence of chloroform, it is sometimes remarkably slight, while at other times it is so severe as to require large quantities of anodyne medicines for its subjugation. When the pain is complicated with spasmodic twitching of the stump, as it generally is during the first twenty-four hours, it must be promptly met with morphia and antimony. In order to render these two phenomena as light as possible, I have long been in the habit of administering a full anodyne, generally a grain and a half of morphia, about two hours before the operation, and have never been disappointed in my expectations.

d. The *inflammation* consequent upon an operation of this kind may be either of the ordinary character, or it may be erysipelatous, the determining circumstances not being always appreciable. In general, however, the danger of erysipelatous action will be considerable when there has been severe shock, or excessive loss of blood, conjoined with previous bad health or habits of intemperance. It usually makes its appearance within the first forty-eight hours, and is characterized by the ordinary phenomena, such as a red dusky state of the skin, more or less throbbing, a sense of tension, and burning, smarting pain, with marked disorder of the general system. Whatever may be the degree or character of the inflammation, it is always hostile to the adhesive process; some parts may, it is true, unite in this way, but suppuration will be almost certain to follow, so as to lead to the necessity of healing the greater portion of the wound by granulation. In persons of a very dilapidated constitution the inflammation may pass into gangrene. I have found this termination most commonly in patients of a scrofulous habit of body and in those whose system has been contaminated by syphilis.

The treatment of this disease must be conducted upon general antiphlogistic principles. Special attention must be paid to the state of the system, and with this view it will generally be necessary to employ a mildly stimulating course, consisting of quinine and milk punch, with blue mass and ipecacuanha to evacuate the bowels and correct the secretions. Morphia is given in liberal doses to allay pain and procure sleep. The best local remedies are the dilute tincture of iodine, with fomentations, or cataplasms, medicated with solutions of acetate of lead and opium. Leeches will generally prove prejudicial. Sometimes the disease is promptly arrested by the application of a large blister. If mortification is threatened, the parts are freely touched with nitrate of silver, sulphate of copper, or the dilute acid nitrate of mercury, and enveloped in a fermenting poultice. The chlorides are used for allaying fetor, and the syringe for washing away secretions from beneath the flaps.

e. Bad effects occasionally follow amputation in consequence of the development of *osteomyelitis;* an affection which has only recently begun to attract particular attention. In the Crimean war it was of such frequent occurrence that the question was seriously debated by a number of surgeons whether it would not be best to abandon amputation altogether in the continuity of the larger bones, and resort to disarticulation as a substitute. The disease is also sufficiently common in hospital and private practice, especially in cases of railway and other severe accidents, attended with violent concussion of the osseous tissues. The probability is that it is occasionally caused by injury inflicted in the act of sawing off the bone. However induced, it generally sets in within a short period after the operation, so that by the time the dressings are removed, as they usually are on the fourth or fifth day, it is found to have already made considerable progress, the marrow being of a brownish, blackish, or greenish appearance, of a soft, putrilaginous consistence, excessively fetid, and partially detached from the bone, which is itself either dead, or in a dying state, and more or less denuded of periosteum. The disease is generally attended with considerable pain, although in some of the cases that I have seen there was almost an entire absence of local suffering; it is not unfrequently coincident with pyemia and erysipelas. Hence the prognosis is often exceedingly unfavorable.

The treatment of osteomyelitis must be conducted upon general antiphlogistic principles, modified by the peculiarity of the constitutional symptoms. Great attention must be paid to cleanliness; the dressings must be frequently changed, and free use must be made of the chlorides. The judicious application of the nitrate of silver to the affected structures might possibly assist in circumscribing and ultimately arresting the morbid action. If the bone die, no attempt should be made to remove it until the part and system have sufficiently recovered from the effects of the disease to bear the shock of the operation.

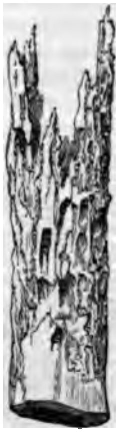
f. Finally, amputation is occasionally followed by inordinate *retraction* of the muscles, so as to uncover the bone, and perhaps lead to the necessity of its removal. The accident is most liable to happen after amputation of the thigh, in consequence of the action of the numerous, large, and strong muscles in that situation, and cannot always be prevented even when more than ordinary care is taken in forming the stump. The occurrence is always to be deprecated, inasmuch as it not only interferes with the union of the flaps but is very apt to cause the death of the bone. The remedy consists in bandaging the limb firmly from above downwards, preceded by the application of long adhesive strips, and in placing the parts in the best condition for relaxing the affected muscles. When these means are unavailing, we may, provided the bone remains sound, divide some of the muscles of the stump subcutaneously, and then draw them forward, either with or without incision of the integuments, as the case may seem to demand. If the bone, however, be diseased, the best plan will be to saw it off higher up; but such an operation is often more hazardous than the original one, and should, therefore, always, if possible, be avoided.

2. SECONDARY AFFECTIONS.

The most common, as well as the most serious, secondary defects of amputation are, as was previously stated, necrosis of the bone, neuralgia, development of synovial bursæ, varicose enlargement of the arteries, and permanent shortening of the tendons in the vicinity of the stump.

a. Disease of the *bone*, eventuating in a loss of its vitality, is induced in various ways; in general, it is caused by injury inflicted upon it during the operation, consisting either in the laceration and separation of the periosteum, or in the violent and destructive jarring of its substance. Uncovering of the bone, in consequence of too great a brevity of flap, and the accumulation around its extremity of pus, are also very apt to produce it. In rare cases it would seem to perish from excess of inflammatory action. The loss of vitality is indicated by the peculiar whitish or pale yellowish aspect of the bone, the absence of bloody points upon its surface, and the fact that it emits a characteristic hollow noise when it is struck with the handle of the knife. The marrow and its enveloping membrane generally retain their vitality for a short time after the osseous tissue has died, and this is the more likely to happen if the bone perishes only in a part of its circumference. I believe it will be found that necrosis, as a result of amputation, is more liable to occur in the thigh-bone than in any other piece of the skeleton, depending probably upon some peculiarity of organization. The tibia is also occasionally affected, and a similar occurrence is sometimes met with in the humerus. The dead bone may come off in the form, first, of an exfoliation, consisting merely of a part of its outer compact substance; or, secondly, as an osseous ring, with long, narrow, sharp spicula; or, finally, as a complete cylinder, as when it involves the entire circumference of the bone over an extent of several inches in length. The more common appearances exhibited by the necrosed bone are well displayed in fig. 171.

Fig. 171.



The sequester detached; at its lower part, *a*, including the whole thickness of the bone, but gradually shelving upwards, as such pieces usually do.

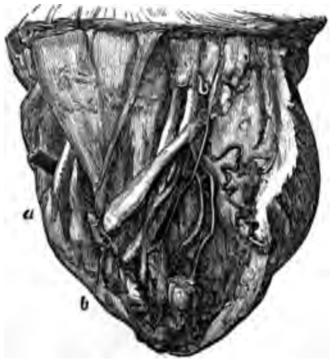
The management of these cases must be left very much to the operation of time, especially when the bone has perished high up, and when, in order to reach it, extensive dissection would be required. If, on the other hand, the necrosis is very limited, an attempt may be made to get rid of it with the saw, cutting-forceps, or trephine; but too much caution cannot be used even in such an operation, trifling though it may seem. I have seen death produced by it in two cases, and similar instances have been witnessed by others. It would seem, when a bone is thus affected, as if the system were more than usually intolerant of instrumental interference and loss of blood; the parts are generally excessively irritable, and the constitution rarely fails to sympathize with them in the most lively manner. Besides, the operation is necessarily attended with some degree of hemorrhage, and I am not certain that a patient may not be destroyed in this way alone, especially if he be very feeble and irritable at the time.

Instances occur in which the dead bone, or sequester, is firmly, and even obstinately, imprisoned by the remains of the living, or, more properly speaking, by the new matter thrown out upon its surfaces; thus occasioning great difficulty in regard to its removal. Dr. Markoe, of the New York Hospital, had the kindness, a few years ago, to communicate to me the particulars of a case, wherein the sequester, consisting of an inner shell of the femur, was retained for many months by a spur of new osseous substance extending through an opening in its sides, in such a manner as to nail the dead and living parts together, but at the same time allowing the former to be moved freely backwards and forwards upon the latter. It was not until after several attempts had been made at extraction, attended with much pain and constitutional suffering, that riddance was finally effected by means of the chisel and forceps. For some very ingenious notions respecting the causes of necrosis in the bones of the stump after amputation, the reader is referred to a short paper by Dr. Markoe, in the Louisville Medical Review for July, 1856.

b. Another disagreeable, frequently, indeed, a most distressing effect of this operation, is *neuralgia*, coming on at a variable period after its performance, and often continuing, despite the most judicious and persevering efforts at relief, to molest the patient during the remainder of his life. Supervening generally without any assignable cause, it is usually most common in nervous, irritable persons, who are subject to the disease in other parts of the body. Females are more prone to it than men, and in them the attack frequently coincides with the eruption of the menses. Sometimes the disease is periodical, especially in residents in malarious regions, the paroxysms coming and going very much as in intermittent fever. Most commonly, however, the pain is omnipresent, one portion of the day being as liable to bring it on as another. It is generally of a darting, shooting nature, or dull, heavy, and aching, and is invariably aggravated by damp states of the atmosphere, fatigue, and disorder of the digestive apparatus.

In the more violent forms of this affection the immediate cause of the difficulty is a bulbous enlargement of the nerves ramifying through the stump, as in fig. 172. This degeneration takes place, to a greater or less extent, after nearly every amputation, and is therefore to be considered as a disease only when it exists in excess. Under such circumstances the tumor, which sometimes attains the size of a hickory nut, or even of a pullet's egg, is of a firm, dense consistence, and is composed of a strong fibrous stroma, inlaid with hypertrophied and curiously interlaced nervous trunks and filaments. It is, in fact, a true neuroma. The accompanying pain is exquisite, and the part is so sensitive as to be intolerant of the slightest touch; the general health is much affected, and the patient is remarkably susceptible of atmospheric vicissitudes, every change in the weather from warm to cold and dry to wet being followed by an increase of suffering. The malady is of a much more serious character than the other, and requires proportionably stronger measures. In general, nothing short of removal will avail; by excision, if the

Fig. 172.



Neuromata of stump, after amputation of the arm. A large mass at *a*; opposite *b*, the tumors are more defined.

tumor be single and easily accessible, by amputation, if it be multiple and deep seated.

For the milder varieties of neuralgia the ordinary remedies will sometimes suffice, the same as in neuralgia in other parts of the body; especially quinine, or, if the patient be anemic, quinine and iron, combined, in either case, with strychnine and arsenious acid, belladonna, stramonium, or aconite; the effects of the articles being studiously watched, lest an overdose be given, and life placed in jeopardy. Sometimes good effects accrue from the exhibition of colchicum and morphia, administered in full doses at bedtime, as one drachm of the wine to a grain of the salt. The remedy is particularly valuable in subjects of a rheumatic state of the system. Locally, iodine, blisters, issues, and other counter-irritants are used, along with anodyne embrocations. The stump is well protected from cold, friction, and pressure.

c. A *burse* sometimes forms upon the stump, generally immediately over the end of the bone, in consequence of the long-continued pressure of an ill-constructed and ill-adapted artificial leg. The tumor, in time, becomes exquisitely tender and painful, compelling the patient to seek relief. The seat and character of the disease are usually pointed out by the discoloration and swelling of the part, which often fluctuates on pressure. The history of the case, aided by the exploring needle, will readily serve to distinguish it from abscess, the only lesion with which it is likely to be confounded. The proper remedy is excision in the severer grades of the affection, and in the milder a more happy adaptation of the artificial to the natural limb.

d. Varicose enlargement of the *arteries* of the stump is extremely rare, only a few instances of it being upon record. Unless the disease is unusually extensive, which, however, it is not likely to be, nothing need be done for its relief, as it does not generally act even as an inconvenience.

e. Permanent shortening of the *tendons* in the immediate vicinity of the stump is sometimes a source of great discomfort, as well as of serious interference with the usefulness of the limb. The accident is most liable to happen in the tendons of the hamstring muscles after amputation of the leg, and in the tendo Achillis after removal of the foot by Chopart's method. Much may be done, in both cases, in the way of prevention by attention to position during the after-treatment; it is, in fact, the neglect of this precaution that usually occasions the difficulty. When the accident is unavoidable, or is already fully established when first brought under the notice of the surgeon, rectification is attempted, generally with a fair prospect of success, by the subcutaneous section of the shortened tendons, and the subsequent use of an extending apparatus, constructed on the principle of the double inclined plane, with such modifications as may be required to adapt it to each particular case.

SECT. VI.—CONSTITUTIONAL EFFECTS OF AMPUTATIONS.

The most common constitutional occurrences after amputations, especially of the larger limbs, are excessive prostration, traumatic fever, pyemia, congestion of the lungs, tetanus, retention of urine, and, as a secondary consequence, hectic irritation.

a. The *shock*, consequent upon amputation, is frequently extremely severe, and may be due, either partly or exclusively, to mere depression of the nervous system, caused by the extent, violence, and duration of the operation, to loss of blood, or to the effects of anæsthetic agents, or to all these circumstances combined. More or less nervous depression will almost necessarily occur during such an operation, however slight, but it generally passes off without any particular treatment, simply under the influence of repose, exposure to the air, and a drink of cold water. In the more severe forms of the affection, however, it may endanger life by its long-continuance or excess, and then demands prompt attention. The most appropriate remedies are lowering of the head, so as to facilitate the flow of blood to the brain; the administration of brandy and ammonia, by the mouth, if the patient can swallow, or by the rectum, if the power of deglutition be lost; a full dose of morphia; and sinapisms to the spine, extremities, and precordial region.

b. Traumatic fever generally sets in within from six to twelve hours after the operation, and will be violent or otherwise according to circumstances, of which the most important are, the extent of the previous shock and the loss of blood, and the temperament, habits, and state of health of the patient. It is characterized by heat and dryness of the skin, flushed countenance, suffusion of the eyes, headache, restlessness, excessive thirst, rapid respiration, and a frequent, hard, and irritable state of the pulse, attended, when there has been much hemorrhage, by a peculiar jarring impulse. These symptoms, in the milder cases, will often speedily subside spontaneously, but under opposite circumstances they will require attention, and, if the surgeon is not fully on his guard, he will be very apt to do a great deal more than is either necessary or proper. The fact is, this is not unfrequently the critical point in such cases; if we do too much, the patient is irretrievably gone, the consequence being death either from exhaustion, pyemia, erysipelas, or a low state of fever, which nothing can cure. Hence the greatest caution is to be observed; the symptoms must be watched, and the utmost care must be taken that they do not deceive us by their violence, which is often rather apparent than real, and therefore extremely apt to entrap the unwary and inexperienced. In general, it will suffice to administer a mild aperient, as a little Epsom salts, or a Seidlitz powder, to sponge the surface frequently with tepid water, and to give cooling, acidulated drinks, which are always very grateful in these cases. If the fever threatens to be obstinate, a little antimony is prescribed, either alone or in union with morphia, to promote perspiration, allay the heart's action, and induce sleep. The lancet is scrupulously withheld, unless the symptoms are of extraordinary urgency, and the patient is very plethoric, without having been weakened by shock and loss of blood. Then a vein in the arm may be opened, and the effect of the stream carefully watched, the bleeding being arrested as soon as the pulse evinces signs of flagging.

Very often after amputations of the larger limbs, especially those performed for compound fractures and dislocations, gunshot wounds, and railway accidents, a low form of fever ensues, the system reacting badly, the countenance looking pale and haggard, the skin being icterode, cold, and doughy, and the pulse shattered, with great depression of spirits, and an utter indifference on the part of the patient as to his fate. It is difficult to say what is the real condition of the system under such circumstances, but if we may be allowed to indulge in conjecture, we may suppose that the disorder is mainly due to the loss of blood and nervous fluid consequent upon the excessive shock to the system at the time of the accident, heightened, perhaps, by the effect of the operation. However this may be, the system being depressed and withered, the issue is usually most disastrous, very few persons recovering, no matter what course may be adopted for their relief. Our chief reliance must obviously be upon stimulants, as brandy, quinine, ammonia, and nutritious broths and jellies, with opium to allay pain and procure sleep.

c. Amputations, especially those of the thigh, are often followed by *retention of urine*, caused apparently by partial paralysis of the bladder, or, rather, as it seems to me, by a want of proper volition, the bladder retaining its power, but the patient being unable to call it into action. It usually supervenes within the first twenty-four hours after the operation, and seldom lasts less than two or three days, when it gradually passes off. From what I have seen of this affection, in this class of cases, I am not disposed to ascribe to it, as some have done, an inflammatory origin; that such a condition occasionally exists is certain, but, in general, I am sure it does not. Knowing how frequent retention of urine is after this and other capital operations, the attendant should be diligently on the watch for it, and promptly use the catheter, if it should arise.

d. A not unfrequent event after amputation is *pyemia*. Experience shows that it is most to be dreaded in cases preceded by excessive shock of the system; hence it is very common after gunshot, railroad, and steamboat accidents, attended with extensive laceration of the soft parts, and after compound fractures and dislocations. From an interesting paper "On the Causes of Death after Amputation," by Mr. Thomas Bryant, of London, it appears that of 300 cases of this operation collected from Guy's Hospital, pyemia occasioned death in 42 per cent. of all the fatal cases, and in 10 per cent. of the entire number, the affection having been most frequent after amputation of expediency, and least so after secondary amputation. The attack generally comes on within the first six or seven days, being ushered in by violent rigors alternating with flushes of heat, and followed by a bad state of the stump with aching pains in the limbs and joints, excessive thirst, restlessness, and a tendency to delirium even early in the disease. When the joints are involved there is commonly an erysipelatous blush upon the overlying skin, with great tenderness on pressure and exquisite pain on motion. The case generally proves fatal in less than a week from its commencement, and examination after death usually reveals the existence of small and ill-defined abscesses in some of the internal organs, particularly in the lungs, liver, and spleen.

The treatment is by stimulants and tonics, as brandy and milk, quinine, and opium, given in large quantity to support the rapidly sinking powers of nature. Mercury, in the form of calomel, is sometimes useful, administered in doses of three grains every four or six hours, with a view, if possible, of touching the gums. The bowels are moved by enemas, all active purgation being inadmissible. Locally, the ordinary remedies are employed, generally only such as are of a soothing character.

e. Congestion of the lungs, if not actual inflammation of these organs, is another effect of this operation, occurring either alone, or in conjunction with pyemia, erysipelas, or an adynamic state of the system. It generally comes on in a slow, insidious manner, and is therefore apt to make serious, if not fatal, inroads before its true nature is even suspected, none of the characteristic signs of pneumonic disease being present. The only way in which it is usually detected is by auscultation and percussion, or by the changes perceptible in the respiratory movements and the sounds of the chest. These changes are generally most conspicuous in the lower and posterior portions of the lungs, where the greatest amount of blood, in debilitated states of the system, is, in obedience to the laws of gravity, most liable to accumulate, and, consequently, to produce the greatest degree of mischief. In most of the cases of pulmonary congestion that I have met with after amputation of the larger limbs, there was either an entire absence of pain and cough, or these symptoms were so trivial as, of themselves, to attract hardly any attention. The patient is able to lie upon his back or on either side, and it is not often that the respiration is materially hurried or embarrassed. Cupping and blistering are the most reliable local remedies, and the system must be supported with stimulants and tonics, aided by morphia and minute doses of tartrate of antimony and potassa. The prognosis is generally unfavorable, especially if the disease has made considerable progress and the patient is much exhausted.

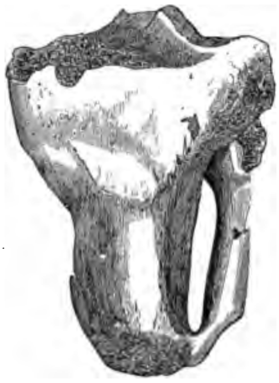
f. The occurrence of *tetanus* after amputation is uncommon, especially in the more temperate regions of this and other countries. Mr. Curling, in his work on this disease, gives a table of 128 cases of traumatic tetanus, three of which only were caused by amputation. The affection is much more frequent in military than in civil practice, and is most liable to be produced in persons of a nervous, irritable temperament, in consequence of exposure to direct currents of cold air. A few years ago I lost a man on the third day after an amputation of the thigh solely from this cause; he had been moved, during my absence from the hospital, to an open door, so as to allow the wind to blow upon him in a full stream. I am familiar with the history of other cases that have been induced in a similar manner; and I refer to the fact in order to attract special attention to it. The treatment of this disease being discussed elsewhere, it is unnecessary to refer to it here.

g. Hectic irritation is observed only, or chiefly, as a secondary effect of amputation, being caused either by profuse suppuration, or a poisoned state of the blood and solids, from shock, hemorrhage, or the absorption of pus. The symptoms are characteristic, and the treatment consists of such means as are calculated to sustain the flagging powers of the system, especially quinine and iron, with aromatic sulphuric acid, milk punch, and nutritious food.

SECT. VII.—ARTIFICIAL LIMBS.

The stump, after the cicatrization of the wound, gradually undergoes, as might be expected, important changes in its several structures, so as to adapt it the better for the various hardships which it is destined to experience in the daily routine of a business life, and especially for the support of an artificial limb. The muscles, deprived of the power of motion, soon become pale and wasted, and are eventually transformed into hard, dense, cellulo-fibrous bands, entirely destitute of their primitive properties. The bloodvessels are obliterated as high up as their first large collateral branches, and converted into solid, rigid cords; the extremities of the nerves are expanded into large bulbous masses, of an elongated, cylindrical shape, exhibiting more of a fibrous than of a nervous structure; and the ends of the bones are rounded off, and covered in by a thin shell of osseous matter, which thus effectually closes the medullary canal, as seen in fig. 173. The cellulo-adipose substance gradually disappears, and the skin, unless habitually subjected to pressure, is rendered abnormally thin and sensitive. These changes are, of course, the work of time, and hence they are always more conspicuous in proportion to the age of the stump.

Fig. 173.

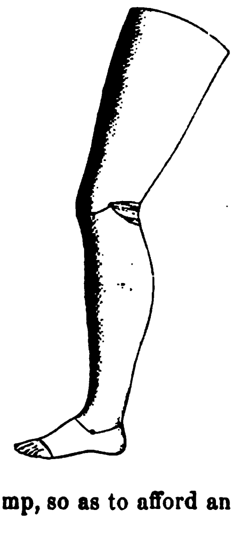


Appearances of bony stump after amputation.

The period at which the stump may be in a condition for the reception and support of an artificial limb must necessarily vary according to circumstances; if the operation has been well done, and the cicatrization has gone on favorably, the substitute may be used as early as the sixth or eighth week, though in general it will be better to wait some time longer, inasmuch as too early a recourse to it will be likely to render the parts sore and sensitive, if not the seat of ulceration and severe pain. So much, indeed, is the patient's comfort influenced by attention to this point that it is hardly possible to be too cautious respecting it. The stump should be tightly bandaged for several weeks previous to the application of the artificial limb, to promote absorption of redundant material, and thus impart to it a somewhat conical shape. Washing it well several times a day with a strong solution of tannin and alum will have the effect of hardening the integuments, so as to moderate their sensibility and prevent excoriation.

Great improvement has of late years been effected in the construction and adaptation of artificial limbs, and there is reason to believe that the inconvenience and suffering occasioned by their use are more frequently attributable to the misconduct of the surgeon than to the want of skill on the part of the manufacturer of the substitute. It has been only within a comparatively recent period that operators have hit upon the correct principles of making good and serviceable stumps; Allanson, nearly three-quarters of a century ago, understood the subject much better than it has been understood since, if we except the last ten or fifteen years. He strongly insisted upon a long and well-shaped stump, and exerted himself with great ability, but in vain, to induce the profession generally to follow his example. The happy changes which have lately been introduced into this department of operative surgery are, I believe, mainly due to the manufacturers of artificial limbs, who, with an ingenuity and a perseverance worthy of so good a cause, have reduced the whole process to one of principles founded upon the study of anatomy and mechanical philosophy. It would be difficult to conceive of any apparatus more beautiful in its construction, or more admirably adapted to the end proposed, than the artificial substitutes of Mr. Palmer, of this city, who obtained the prize medal at the great exhibition in London in 1851. Combining lightness with strength, and neatness with symmetry, they are worn with great comfort and satisfaction, and are apparently as perfect as any piece of human mechanism of the kind can well be made. The joints, constructed on the principle of the ball and socket articulation, are situated at the proper points, and their surfaces being well secured, move upon each other with great accuracy and facility, through the intervention of cords, wires, springs, and levers, the whole arrangement being a close imitation of the natural muscles and tendons, if not in shape, at least in position and function. The socket is made with special care, neatly fitting the stump, in every portion of its extent, and is well padded to prevent friction and excoriation, the pressure being diffused over the entire circumference of the stump, while the extremity of the latter is perfectly free in the interior of the former. The annexed cut, fig. 174, affords an illustration of this apparatus.

Fig. 174.



To enable the patient to wear his artificial limb with comfort and convenience, it is necessary that he should have a good long stump, well covered, perfectly even, and of proper shape, being neither too square and fleshy, on the one hand, nor too thin and conical, on the other. A short, thick, ill-formed stump is a great evil, from which the patient can promise himself no good; but which can hardly fail to be a constant source of annoyance and pain, becoming sore and excoriated under the slightest exercise. The duty of the surgeon is, therefore, one of great responsibility, and cannot be discharged without properly weighing, in every instance, the probable consequences of the operation. When he has his choice, his invariable aim should be to make a long stump, so as to afford an abundant leverage and support for the artificial contrivance. In the leg and thigh its length should not, if possible, be less than nine or ten inches; hence the place of election, for the former, should be only about from three inches to three inches and a half above the ankle, and for the latter about the same distance above the knee. It is not always by any means, however, in the power of the surgeon to select the point where he might otherwise cut off the limb, and under such circumstances he must be contented in leaving as much substance as he can. If the leg is amputated very high up, the weight of the body may be supported upon the knee, especially if the patient's social position is such as to prevent him from wearing an expensive substitute, and this will be the more necessary because it is often very difficult, if not impossible, to preserve the straightness and flexibility of the joint in the event of a very short stump, on account of its incessant tendency to retraction and anchylosis. It is for this reason that some surgeons have advised amputation of the thigh just above the knee, when accident or disease interferes with the formation of a suitable stump below; but, if we consider the difference in the danger of the two operations, we should hesitate before we give our sanction to such counsel, not forgetting that the risk increases with every inch the nearer we approach the trunk. In amputation of the thigh, the principal pressure of the artificial limb upon the stump is concentrated near the body, but care is taken not to apply any direct pressure to the perineum, lest it should produce excoriation.

I subjoin Mr. Palmer's instructions for the formation of suitable stumps in amputations of the leg and thigh, as they are now generally acted upon by the more accomplished operators of the country. For the leg, the first choice is the inferior third or fourth of the limb; the second, the lowest point between this place and the upper third of the leg; and the last, immediately below the tuberosity of the tibia, if not practicable to save four inches below the patella with the full use of the knee-joint. Whatever the seat of the operation may be, the best stump will be one made of flaps.

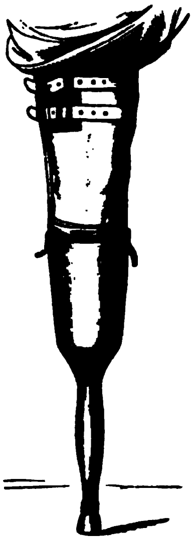
In amputations of the thigh, the first point of election is the lower third of the limb, so as to give at least ten inches from the perineum; if performed near to or at the knee, there must be complete removal of the condyles of the femur. Secondly, if necessary to go above this point, the object should be to save as much of the thigh as possible. In either case, the flap operation makes the best stump for the comfortable use of an artificial substitute.

In amputations in children, the development of the limb is always partially arrested, so that, by the time the individual attains his full stature, it will be several inches shorter, as well as thinner, than its fellow of the opposite side. Now, surgeons in applying this knowledge to amputations of the inferior extremity, have advised that it should never be cut off below the knee, but at the lower third of the thigh, on the ground that, if this precaution be neglected, one knee will ultimately be elevated a considerable distance above the other, thereby imparting to the gait a peculiar grotesque appearance. Experience, however, has shown that amputation of the leg, even if the stump is only a few inches in length, instead of being an objection, is a decided advantage, the limb thus affording a much longer leverage than when it is cut off through the thigh, for the adaptation of the artificial substitute, the knee-joint of which can always be made to correspond, in situation, with that of the sound limb. Moreover, by adopting this procedure, the weight of the body, provided the stump is not too long, is supported upon the knee; another most important desideratum under such circumstances.

An ingenious artificial limb was recently devised by Dr. Bly, of Rochester. Besides combining lightness with elegance, durability, and strength of construction, it claims the advantage of admitting of lateral motion at the ankle-joint, with a view of facilitating progression. The contrivance appears well in the model, and is said to work admirably in practice.

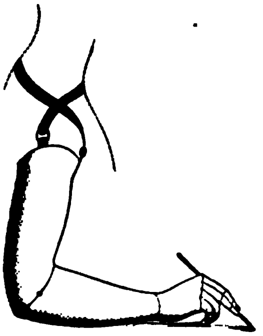
The annexed drawing, fig. 175, conveys a good idea of the artificial limb usually worn by the laboring classes after the loss of a leg or thigh. It may be made very light, and, when the stump is of proper length, affords an admirable substitute, the person being able to walk nearly with the same facility as in the natural state.

Fig. 175.



Various attempts have been made to construct artificial hands and arms. Mr. Palmer, after many trials, has at length devised a limb, fig. 176, which, in point of neatness and adaptability, leaves hardly anything to be desired upon the subject.

Fig. 176.



SECT. VIII.—MORTALITY AFTER AMPUTATIONS.

The mortality from amputations is so much influenced by extraneous and intrinsic circumstances, and requires such a vast amount of statistical material for comparison and contrast, that it is extremely difficult, if not impossible, in the existing state of the science, to arrive at any satisfactory conclusions respecting it. It has long been known that the danger of the operation is greater in proportion to its proximity to the trunk and the size of the limb. Hence, amputation of the leg is less hazardous than amputation of the thigh, and of the thigh in its continuity than of the thigh at the hip-joint. The mortality of the operation is also greater, as a general rule, in hospital than in private practice, in military than in civil practice, and in private practice in cities than in the country. Amputations on account of railway accidents are extremely dangerous, and are liable to be followed by the worst consequences, even in subjects perfectly healthy at the time of the accident, owing to the excessive tendency to mortification and pyemia.

The circumstances which mainly influence the mortality after amputation may be conveniently arranged into four classes, one of which refers to the age, previous health, and social position of the patient; the second to the causes necessitating the operation; the third to the nature, seat, and extent of the operation; and the last to the after-treatment.

1. It will readily be granted that the condition of the *patient* at the time of the accident rendering amputation necessary must exert an important influence upon his fate. If he be old, broken in constitution, or in a state of poverty, so as to preclude the possibility of receiving proper attention after the operation has been performed, the chances are that he will die, either

from shock, erysipelas, pyemia, or congestion of the lungs. The previous state of his health exerts no little influence upon the recovery; not, perhaps, however, to the extent that is generally imagined. A person who is in bad health at the time he is severely injured cannot be expected to bear the shock of an amputation with the same impunity as one whose health is good. The system, exhausted by previous suffering, is ill qualified in such a case to react favorably after the nervous depression consequent upon a severe operation.

Age also exerts considerable influence over recovery. Children, as a general rule, bear amputation better than adults and elderly persons, being less subject to attacks of erysipelas and pyemia, and making a more rapid recovery. The parts, too, unite more frequently by the first intention. At the Hôpital des Enfants in Paris, Guersant, who annually performs from fifteen to twenty operations of this kind, including all the larger limbs, and also occasionally the hip and shoulder joints, does not lose more than one out of about nine cases. He ascribes his extraordinary success mainly to two circumstances; first, a thorough preparation of the system, and secondly, the use of an abundance of good, wholesome, and nutritious food immediately after the operation, on the well-known principle that children do not tolerate abstinence nearly as well as adults. It should be added that nearly all the cases in this Institution demanding amputation are of a scrofulous nature.

The social position, or the habits and occupation of the patient, will influence the result of an amputation. The poor man cannot command the same care and attention as the rich; he often suffers for want of proper food and nursing, and even medicine, at a time, perhaps, when he is most in need of them, and there is no doubt that many patients perish from this cause alone that might otherwise be saved. Intemperance in eating and drinking, and unwholesome occupations must necessarily produce a prejudicial influence upon the result.

2. The influence of the *causes* necessitating amputation has long been a subject of remark on the part of practitioners, both in private and public. Thus, it is an established fact that a person who undergoes amputation of one of the larger limbs on account of a severe injury, as a compound fracture, or a lacerated and contused wound, is much more likely to perish from its effects than one who loses a limb on account of chronic disease. The system, in the former case, deeply depressed by the shock of the accident, often reacts very slowly and imperfectly, and is therefore ill prepared for the approaching ordeal of another severe commotion, the effect of which is felt by every organ and tissue of the body. In disease, on the contrary, the constitution, although perhaps extensively implicated, has become inured to suffering, and, unless too much prostrated, will generally be immensely benefited by the removal of the offending parts. The chief exception to this rule is in malignant affections, in which, in consequence of the vitiated state of the solids and fluids, amputation is often followed, and that very rapidly, by the worst results.

3. In considering the probable result of a case of amputation, we must not forget to take into view the nature, seat, and extent of the *operation*. Experience has proved that, in civil practice, primary amputation is, other things being equal, a decidedly more dangerous procedure than secondary. The very fact that such an operation is required shows that the accident for which it is performed must have been a severe one, involving, perhaps, the most dreadful lesions of the bones, muscles, joints, and bloodvessels, with frightful depression of the nervous system. Now, it is surely impossible that a patient thus circumstanced should be in a favorable condition to submit to another severe shock, such as must necessarily attend the removal of the affected limb, within a short time after reaction has been established. The statistics, both of private and hospital practice, in America and Europe, are decisive upon this subject, proving beyond the possibility of doubt, the greater mortality

after primary than secondary amputations. Thus, of 48 primary amputations of the thigh, leg, and arm, performed in the London hospitals from June, 1855, to June, 1856, inclusive, 26 terminated fatally, or upwards of one-half, while in 156 secondary ones the number of deaths was only 35, or in the ratio of about 1 to 4½.

In military practice, on the contrary, the results of amputations are reversed, the primary being incomparably more favorable than the secondary. This has been the result of the experience of surgeons in all ages and in all countries since the invention and use of gunpowder. Larrey and Guthrie saved three-fourths of their cases after primary operations, and the returns of the British surgeons in the Crimea are of a similar character, although the rate of mortality here was considerably higher, owing to the fact that most of the wounds were inflicted with the conical ball; whereas, in the campaigns of Bonaparte, and in the Peninsular war, they were made with the round ball, the effects of which are, as a general rule, much less destructive than those of the former.

The differences between the results of primary and secondary amputations in civil and military practice, are no doubt due to the circumstances under which they are performed and the causes which lead to their necessity. In the first place, there is generally less shock in injuries received on the field of battle than in those received in civil life. Secondly, the soldier usually submits to the removal of his limb with greater *sang-froid* than the civilian, and often glories in his loss, believing that the world will regard it as an evidence of his prowess and patriotism; whereas, the latter finds in his misfortune nothing but regret and private calamity. Thirdly, the operation is commonly more promptly performed in military than in civil practice, delay, in the latter case, being frequently occasioned by the doubts of the surgeon and the interference of the patient and of his friends; and, lastly, a soldier has not much chance of recovery from an amputation, when, an attempt being made to save his limb, he is subjected to rough and tedious transportation, and is afterwards obliged, when the operation has been performed, to breathe the contaminated atmosphere of a crowded hospital, tenanted by persons borne down by similar accidents. Under such circumstances the mortality from erysipelas, pyemia, and typhoid fever will, other things being equal, be much greater than in private practice. Faure, from these and other causes, lost 270 out of 300 secondary amputations consequent upon injuries received in battle.

The size and situation of the wound exert an important influence upon the recovery. Here again the statistics furnished by various authorities are most eloquent and decisive. They have conclusively established the fact, now regarded as a great general law, that the larger the wound is and the nearer it is to the trunk, the greater is the danger to life. Thus, Malgaigne, in his statistics of amputations of all kinds in the hospitals of Paris, found that the mortality after removal of the great toe was in the ratio of one to six, whereas that of one of the smaller toes was only as one to twenty-six. In amputations of the foot the proportion of deaths was about twenty-five per cent., of the leg fifty-six per cent., and of the thigh sixty-two per cent. These results have been abundantly verified by the statistics of other institutions, as well as by those of military and private experience, and they are full of interest, as establishing a law, which should never, if possible, be violated in practice.

The causes which induce this difference in the larger and smaller amputations are chiefly shock, hemorrhage, pulmonary congestion, pyemia, erysipelas, profuse suppuration, and gangrene of the stump. Tetanus, too, is more frequent after the former than the latter, although the mortality from this affection is not great under any circumstances, especially in the more temperate regions of this and other countries. It is certainly not difficult to understand the reason why the removal of a large limb should be attended with so much more risk than that of a small one. In the former case, the patient has to contend not only with the shock of the accident necessitating amputation, which is often of itself almost sufficient to destroy him, but as soon as reaction is established he is subjected to another source of depression, perhaps almost equally great, from the operation, frequently involving copious hemorrhage, and liable to be followed by profuse suppuration and high febrile excitement, all tending to depress and exhaust the vital powers. In the latter, on the contrary, there is little or no shock, either from the accident or the operation; the loss of blood is inconsiderable; and the inflammatory effects, local and constitutional, are comparatively trivial. In short, there is no disorganization of the blood as there is in the former, and hence no predisposition to pyemia, or purulent infection, and pulmonary congestion, which are a source of so much mortality after the large amputations performed for severe injuries.

The result of an amputation may be materially affected by the situation at which the bone is divided. Experience has shown that, in the femur, tibia, and humerus, more particularly, the danger is much greater when the bone is sawn through its shaft than when it is cut off at its articular extremity, owing to the injury inflicted upon the endosteum, and the consequent liability of this membrane to diffuse suppuration, and other bad effects.

4. Finally, it needs no labored argument to prove that the mortality from amputation must be materially affected by the nature of the *after-treatment*. That many persons perish after such an operation from sheer neglect, bad nursing, or bad surgical management, is a fact too well known to require comment. This is true both of private and of hospital practice, but the remark applies with increased force when it is made with reference to military practice, which, however well the surgical staff of an army may be organized, must often, from the very necessity of the circumstances in which the operations are performed, and the difficulty of conducting the after-treatment in a proper and satisfactory manner, be followed by the most disastrous results, many lives being lost that might, under more auspicious circumstances, as to locality, comfort, and convenience, be saved. The state of the atmosphere, as it respects purity and temperature, the prevalence of epidemic diseases, mental depression, want of proper diet, severe depletion, and inattention to the dressings, all exert a more or less powerful influence upon the issue of such an operation. The crowded wards of hospitals in large cities, incessantly pervaded by foul air, are notoriously prejudicial to recovery after amputations; gangrene, exhausting suppuration, erysipelas, and pyemia are the common lot of such patients, and the consequence is that many of them perish. Hence it is that private practice, especially that of the country, always shows a much more favorable result than that of large public institutions, or that of large towns and cities. During epidemic diseases, the percentage of deaths from amputations always exhibits a great increase; for it is then that patients are particularly prone to erysipelas, pyemia, and congestive pneumonia. Starvation and depletion are a serious source of mortality after this operation, establishing, as it does, a tendency to purulent infection and a typhoid state of the system, from which often no stimulants, however powerful and well-directed, can afterwards rouse it. I regard such treatment after amputation of a large limb, as, indeed, after every other capital operation, as a great evil, and one which, in my judgment, demands thorough reform on the part of our civil and military practitioners. Finally, I may mention, as another source of mortality, want of attention to the dressings, which, if allowed to remain on too long, not only taint the surrounding atmosphere, but favor the absorption of pus, much to the detriment both of the part and system.

I subjoin the following summary of the statistics of the amputations performed at the Pennsylvania, New York, and Massachusetts Hospitals, because it seems to place the whole subject of the mortality after these operations in a clear and satisfactory light. It is founded upon the reports of Dr. Norris, Dr. Lente, and Dr. Hayward, and embraces the results of five hundred and forty-six cases.

Dr. Norris's statistics of amputations at the Pennsylvania Hospital comprise a period of twenty years, extending from 1831 to 1850 inclusive. The whole number of operations upon large limbs is 174, of which 44 proved fatal, thus exhibiting a mortality of 25.2 per cent. The whole number of amputations of the thigh was 33, of which 8 were fatal, or nearly one in four; of the leg 69, with a mortality of 29, or 42 per cent.; of the knee 1, which was successful; of the arm 32, of which 5 perished, or one in six and a third; and of the shoulder-joint 6, of which 1 proved fatal.

Of 52 primary amputations of the lower extremity 25 were fatal, while of 28 secondary operations only 8 were fatal, thus exhibiting a mortality of 28.6 per cent. as compared with 48 of the former. Of 22 amputations of the inferior extremity for disease 4 were fatal, yielding a mortality of 18.1 per cent.

The ages of the patients operated upon were as follows:—Of 49 under 20 years, 4 died; of 56 between 20 and 30, 11 died; of 47 between 30 and 40, 18 died; of 37 between 40 and 50, 13 died; and of 5 over 50, 1 died.

The above summary will be found, on comparison, to differ essentially, in one particular, from that given by Dr. Norris himself, in his statistics. Thus, he makes 115 primary amputations of the thigh, leg, arm, and forearm, yield a mortality only of 27, or at the rate of 23.4 per cent., while 41 secondary amputations of the same limbs afford a mortality of 16, or at the rate of 39.3 per cent. Now such a result is, as is well known, wholly at variance with general experience, for it is universally admitted that secondary amputations are less fatal than primary; and it must always be so from the fact that primary amputations are commonly performed for more serious injuries than secondary, injuries which are often of themselves almost inevitably fatal under any treatment, such as the crushing of limbs by railway cars, heavily-loaded wagons, ferry-crossings, high falls, and gunshot wounds, involving joints, large vessels, and other important structures. On the other hand, the very circumstance of waiting for secondary amputation indicates a comparatively slighter lesion, and generally a fair prospect not only of saving life but of limb also. But the explanation in the discrepancy in Dr. Norris's statistics is discovered in the fact that he classes as primary only those cases in which the operation was performed during the first twenty-four hours after the occurrence of the accident, whereas the general rule is to regard every instance as primary until a sufficient degree of reaction has taken place to justify the use of the knife, without taking lapse of time into account at all. Thus, if we wait for the system to come up, an amputation performed on the second day has as much claim to be classed as primary as though it had been performed on the first day, and, indeed, it seems almost impossible, if we reject Dr. Norris's rule, to specify any certain demarcation, as to time, between a primary and a secondary operation. We therefore consider those amputations as secondary which are performed after the occurrence of inflammation, or of inflammation and suppuration. Thus, many of the amputations at the New York Hospital, classed as primary, were performed on the second, third, or fourth day, and some even as late as the sixth or seventh. Frequently the delay was caused only by the circumstance that the patient had to be conveyed from a long distance in the country to the hospital; the shock of the injury and the fatigue of the journey preventing such a degree of reaction as to constitute inflammation. It would certainly be improper, and lead to much confusion, in attempts at classification and generalization, to rank such operations as secondary merely on account of lapse of time. In order, therefore, to make a useful comparison of Dr. Norris's very extensive and valuable tables with those of other statisticans, I have taken the liberty of drawing my own deductions. It may also be noticed that no distinction has been made between the relative mortality of primary and secondary amputations of the upper extremity in its continuity, because the mortality is so small as to render such a distinction practically useless.

Dr. Lente's account of the amputations at the New York Hospital embraces a period of eighteen years, commencing in 1839, and terminating in 1857. The whole number of cases was 305, of which 139, or 45.5 per cent., proved fatal. The thigh was amputated in 97 cases, of which 51 were fatal, showing a mortality of 52.5 per cent.; the leg in 102, with a mortality of about 34 per cent.; the arm in 58, with a mortality of 15 cases, or at the rate of nearly one in four; and the forearm in 39, with a loss of 8, or at the rate of 20.5 per cent. Of 4 cases of amputation at the hip-joint all were fatal; of 9 at the knee-joint 4 died; and of 19 cases at the shoulder-joint 11 proved fatal.

It will thus be seen that the number of cases of amputation of the lower extremity was 212, of which 86 terminated fatally, showing a mortality of 40.6 per cent.; and of the upper extremity 106, of which 31 died, the rate of mortality being 30 per cent.

Of the amputations of the thigh 33 were by the double flap method, with a loss of 14, or at the rate of 42.4 per cent.; and 28 by the circular, with a loss of 15, or 53.6 per cent. Of the operations upon the legs 21 were by the flap method, and 58 by the circular, the mortality in the former being 38.1 per cent., and of the latter 22.4 per cent.

Of 70 primary amputations of the thigh and leg, 39 were fatal, exhibiting a mortality of 55 per cent.; and of 73 secondary 32 were fatal, or 24.1 per cent.

The ages of the patients operated upon, with their respective mortality, were as follows: For the lower extremity, under 10 years, 2 cases, both recovered; between 10 and 20, 18 cures and 14 deaths; between 20 and 30, 23 cures and 18 deaths; between 30 and 40, 15 cures and 12 deaths; between 40 and 50, 7 cures and 10 deaths; over 50, 2 cures and 2 deaths.

It would seem that the ratio of mortality after amputations at the New York Hospital, during the above period, was very different in different years. Thus, from 1848 to 1851, of seventeen operations upon the thigh, only four were successful. From 1851 to 1857, the number of amputations of the thigh was forty-six, of which eighteen were cured. During the three years above alluded to, there was a remarkable fatality attending all operations at the institution, owing to the prevalence of erysipelas, hospital gangrene, purulent infection, and kindred diseases. This circumstance led to a remodelling and rebuilding of the establishment, and the good effect is seen in the very great decrease in the mortality which has since occurred. Similar facts have been noticed, from time to time, in other hospitals, both in America and Europe.

The statistics of the Massachusetts General Hospital have been furnished by Dr. Hayward, of Boston, and relate to amputations of the large limbs which occurred from the opening of the establishment to January 1, 1840, the whole number of cases being 67, of which 15 proved fatal, the mortality being thus 22.4 per cent. Of these cases 34 were amputations of the thigh, of which 9 proved fatal, or at the rate of 26.5 per cent.; 23 of the leg, with a mortality of 5, or 21.7 per cent.; 4 of the arm, which all recovered; and 6 of the forearm, of which one proved fatal.

Of 10 primary amputations of the lower extremity 5 were fatal, and of 10 secondary 4 were fatal. Of 37 operations performed for disease 5 died, and it is worthy of note that 23 of these cases were amputations of the thigh.

The ages were as follows:—Under 20 years, 13, of which 1 died; from 20 to 30, 31, of which 8 died; from 30 to 40, 9, of which 3 died; from 40 to 50, 10, of which 2 died; from 50 to 60, 3, of which 1 died; and over 70, 1, which recovered.

Having thus given the results of amputations at each of the above hospitals, it will not be uninteresting to state their aggregate results. The whole number of cases, as already mentioned, is 546, of which 198 proved fatal, thus showing a mortality of 36.2 per cent. The thigh was amputated in 164 cases, of which 68 died, or 41.4 per cent.; the leg in 194 cases, of which 68, or 35 per cent., perished; the arm in 94, of which 20 died, or 21.2 per cent.; and the forearm in 85, with a mortality of 11, or 12.9 per cent.

Of 133 primary amputations of the lower extremity in its continuity 69 died, or 51.9 per cent.; while of 111 secondary amputations only 44 were lost, or 39.6 per cent. Of 117 operations performed for disease 23 died, that is, 19.5 per cent. These cases include several double operations of the legs, and of these a majority recovered. Four amputations at the hip-joint are included in the tables, and all these proved fatal. Of 10 amputations at the knee 5 were lost. Five of the ten were primary, one secondary, and three for disease; of the first two died, of the second one, and of the third two. The shoulder-joint was the seat of operation in 25 cases, of which 12 were fatal, or 48 per cent.

In regard to the ages of the patients operated upon in the three hospitals, the mortality in all under 20 years, was 20 per cent.; between 20 and 30, 29 per cent.; between 30 and 40, 40 per cent.; between 40 and 50, 40 per cent.; and over 50, 33.3 per cent.; the number of cases, however, being only 12, and therefore too small to justify any general deduction as to the rate of mortality.

Respecting the relative mortality of the circular and flap operations, the statistics of the Pennsylvania and Massachusetts General Hospitals are silent, and I am therefore unable to compare it with that of the New York Hospital.

A comparison may next be instituted between the mortality of amputations in the practice of American and European surgeons. In doing this, I shall take as my guide the statistics of the above establishments, and those furnished by Mr. Benjamin Phillips, of London. Of 545 cases, analyzed by the English author, embracing primary and secondary amputations, and amputations for various diseases, of the thigh, leg, arm, and forearm, in France, Germany, and Great Britain, 127 proved fatal, thus exhibiting a mortality of about 23 per cent. Of 491 cases in the three American hospitals, 134 died, giving a mortality of 27.30 per cent., a result somewhat higher than the foreign practice. It is worthy of remark, however, that a number of Mr. Phillips's cases were taken from the private practice of European hospital surgeons, and if we bear in mind the fact that the mortality after amputations is always, for obvious reasons, less, the world over, in private than in hospital practice, it will be found that the ratio of mortality is about the same in the two countries, that is, about 23 per cent.

CHAPTER XVIII.

EXCISION OF THE BONES AND JOINTS.

THE term excision serves to denote the removal of a bone whether in its continuity or at its extremity, whether it be limited to a portion of its extent or embrace its totality. When only the head of a bone is concerned in the operation, the word decapitation is occasionally used, and, as meaning the same thing, some authors have adopted the name of exsection. Excision differs from amputation in this, that, while in the latter the bone is removed along with the soft parts which surround it, in the former the bone alone is cut away, the integuments, muscles, and other tissues being retained, in order that they may contribute to the future usefulness of the limb; or, in other and more comprehensive language, while in the one case all the structures are destroyed, in the other as many of them as possible are preserved. Hence this department of surgery has very appropriately been denominated *conservative* surgery, and it is most gratifying to know that it constitutes one of the leading characteristics of the healing art of the present day. It is not to be expected that excision of the bones and joints will ever entirely supersede the necessity of amputation, for as long as the various tissues of the body are subject to disease and accident, so long will they require removal by the knife, in order to prevent the extension of their effects; but that the frequency of the operation will eventually be greatly diminished, the experience of the last fifteen years abundantly attests. Conservative surgery is still in its infancy, and it is needless to conceal the fact that it will take a long time to determine its legitimate limits. Up to the present moment we have no adequate statistical information respecting excision of any of the bones and joints to justify us in delivering a definite judgment upon its true value. The facts that have transpired in relation to the operation are too widely scattered to render them available for the purposes of a rigid and faithful analysis. Such a task would involve a profound consideration of the history of the operation, in all its varied bearings, and would demand an amount of time, labor, and talent, which few professional men are able to command.

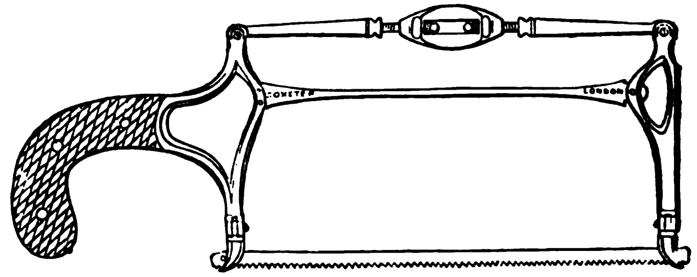
Dr. Oskar Heyfelder, of Vienna, in his work on resections, published in 1861, has tabulated 2,662 cases of these operations, in 2,241 of which only, however, the result is known. Among these cases there were 452 deaths, and 1,616 complete cures; in 1,789 cases life has been preserved, and 173 cases have been unsuccessful.

Although incidental mention of excision of the bones occurs in the writings of some of the earlier surgeons, yet it is probable that, if such an operation was ever performed by them, it was in great measure, if not entirely, limited to the removal of the protruding ends of fractured bones. However this may be, it is certain that there is no well authenticated case of excision of the heads of any of the bones until 1762, when Mr. Filkin, of Northwich, removed those of the knee-joint. Soon after this a similar service was performed for the superior extremity of the humerus by Vigaroux, David, and White. In 1781, Mr. Park, of Liverpool, repeated Filkin's operation, and, from the gratifying success attending it, he was led to propose its extension to all the principal articulations, much to the surprise of most of his contemporaries, who looked upon the measure as harsh and reckless. The consequence was that the proceeding met with much opposition, and it might even have been entirely lost sight of if it had not been for the boldness and skill of Moreau, the elder, of Bar-sur-Ornain, who, towards the close of the last century, exsected, in rapid succession, the articular extremities of the shoulder, knee, and elbow. The success of the French surgeon was followed up by that of his son and successor, who obtained great celebrity for his operations upon the joints, attracting patients from all parts of France, and who, at various intervals, embodied the results of his observation and experience in separate monographs addressed to the Academy of Surgery at Paris and other learned societies. In the early part of the present century excision of the joints received a powerful and salutary impulse from the French army surgeons, particularly Larrey, Percy, Willaume, and Bottin, who repeatedly performed extirpation of the heads of the bones, especially those of the shoulder, on account of gunshot injury. The operation, indeed, was performed, at one time, upon a large scale, and many limbs, as well as lives, were doubtless saved by it. Notwithstanding this, however, the procedure was generally regarded with suspicion in Great Britain, where, although it originated there, it made no real progress until thirty years ago, when, chiefly through the example of Mr. Liston and Mr. Syme, it began to attract the universal attention of medical men. During the last few years the operation has been performed in numerous instances, by surgeons of the highest eminence, upon nearly all the principal articulations, and the results have been such as to warrant the belief that this department of the healing art is destined rapidly to undergo a most salutary change. In this country excision of the joints has hitherto been greatly neglected, both in hospital and private practice; that this, however, will be the case any longer is not at all probable when we reflect upon the intelligence, zeal, and skill of our surgeons. All innovations require time for their adoption, and what De Condillac said of another subject is equally true of this. "Il est rare que l'on arrive tout-à-coup à l'évidence: dans toutes les sciences et dans tous les arts, on a commencé par une espèce de talonnement."

Excision of the bones in their continuity has been practised, for various purposes, for a long time, and modern surgery is indebted to it for many of its most brilliant exploits. It is in this department, more particularly, that American operators have displayed their greatest skill. Commencing with excision of the inferior jaw by Dr. Deadrick, of Tennessee, in 1810, we may with just pride point to the operations of Mott upon the clavicle, of Mussey, McClellan, and Gilbert upon the scapula, of Butt and Carnochan upon the ulna, and of the latter upon the radius, not to mention numerous minor cases, which, although less known, have reflected the highest credit upon the scientific character of the profession, and conferred the greatest benefit upon a class of sufferers who would otherwise have been doomed to loss of limb and life.

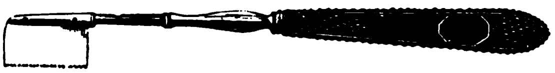
Instruments.—Various instruments are required for the ready and successful performance of this operation, and it is always desirable to have rather too many than too few, so that every emergency may be promptly met as it arises. The incisions through the skin and muscles are made with ordinary scalpels, but for detaching the bones from the soft parts and dividing the ligaments, stout, probe-pointed knives, with broad, steel handles, convex and semi-sharp at the end, will be necessary. Excision of the bone is effected with a hand-saw, a pair of pliers, or the gouge and chisel, according to the structure, size, and situation of the affected piece. The saw, which may be a common amputating one, should be from six to ten inches in length by from three to twelve lines in width, its teeth being sharp and widely set, and its handle long and thick. A saw, lately introduced by Mr. Butcher, of Dublin, and bearing his name, will be found very useful, especially when there is but little space, or when it is necessary to divide the bone obliquely. It has, as will be perceived by a reference to the engraving, a very narrow blade, the angle of which can be changed at pleasure. In addition to these instruments, it will be well to have upon the tray a Hey's saw, fig. 178, and also a very narrow concave saw, fig. 179, with a blunt end, in the event of its being necessary to divide the bone from behind forwards. As to the chain saw, fig. 180, even in its most approved forms, it may well be dispensed with, as its use is generally only productive of delay, vexation, and disappointment. Bone forceps or pliers, figs. 181—2—3, usually known as Liston's, although long ago described and delineated by Scultetus, should be at hand, of various shapes and sizes, as they may frequently be used with great advantage in places where it is impossible to introduce and work the saw. The surgeon should also be provided with several gouges and chisels, a strong mallet, trephines, scrapers, and a large elevator, together with a thick leather strap or leaden spatula for protecting the soft parts during the division of the bone, suitable instruments for holding the flaps apart, and a syringe for washing out the wound or clearing away sawdust and the débris of diseased bone and cartilage.

Fig. 177.



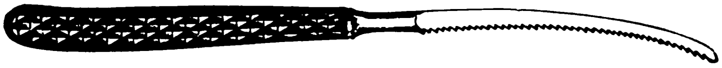
Butcher's saw.

Fig. 178.



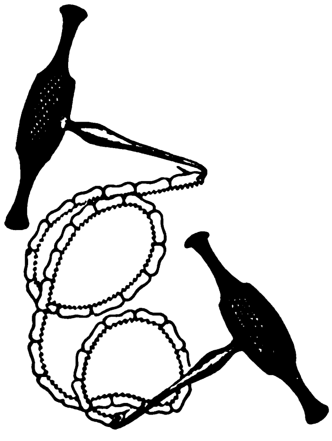
Hey's saw.

Fig. 179.



Curved saw for small bones.

Fig. 180.



Chain saw.

From this catalogue of instruments I have purposely excluded the tourniquet, which is not only unnecessary, but absolutely hurtful in excision of the bones and joints. If proper care be used, the surgeon will seldom lay open any of the more important arteries, none certainly which may not be readily secured by the ligature; there is, therefore, no need of such an instrument, which would only serve to dam up the blood in the larger veins, and thus cause injurious waste.

Fig. 181.

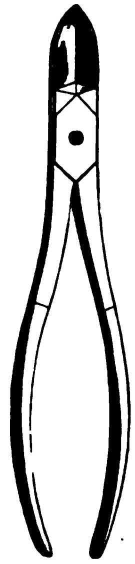


Fig. 182.

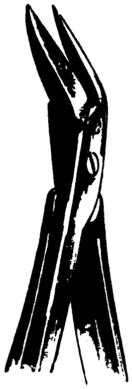
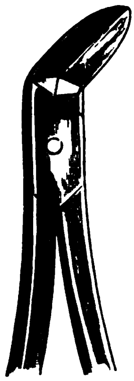


Fig. 183.



Bone forceps.

Position of the Patient.—The position of the patient, the surgeon, and the assistants, as well as the number of the latter, varies in different cases and under different circumstances, and does not admit of any precise rule. Generally speaking, the recumbent posture will be the most suitable, especially if chloroform is given and the operation is at all likely to prove tedious. In cases of any magnitude, as in exsection of the knee-joint, the number of assistants should not be less than five or six; one administering the anæsthetic, two holding the limb, one handling instruments and tying arteries, and another having charge of the sponges.

As it respects the operation itself, it may be conveniently considered as consisting of three stages, the division of the soft parts, the excision of the bone, and the dressing of the wound.

Incisions.—In planning the incisions, care must of course be taken not to interfere with any structures, the division of which might compromise in any way the result of the operation. The sheaths of the tendons are to be especially avoided. To lay them open would be to invite inflammation and plastic deposit, which could not fail to impair their usefulness. The nervous trunks are turned aside, out of harm's way, and the larger vessels, both arterial and venous, are studiously protected from injury.

The number and direction of the incisions will necessarily vary in different cases. Sometimes a single longitudinal cut will be sufficient, even in such a joint as that of the shoulder; in general, however, they should be so arranged as to enable us to form a good-sized flap, either of a semi-lunar, horseshoe, or square shape, as this will afford more ready access to the affected bone, as well as greater facility for sawing it. Incisions made after the manner of some of those depicted in the chapter on minor surgery will afford the surgeon an opportunity of adapting his operations to any case that will be likely to come under his observation.

The elliptical incision may be adopted, if it be necessary to integument on account of disease. Whatever plan be pu is to sacrifice as little soft substance as possible. Even when the flap is very large and unseemly, it must not be retrenched, experience having proved that it will always contract down to the proper dimensions during the progress of the cure. In separating the bone from its muscular and ligamentous connections, the knife must be kept as close as possible to its surface; any deviation from this rule will be likely to be followed by the division of structures which should not be meddled with, especially important bloodvessels.

Removal of the Bone.—Insulation of the bone having been effected, it is next to be pushed through the wound, and sawn off, the parts around being carefully protected from injury by a piece of leather, or a metallic spatula placed underneath. Whenever it is feasible, I prefer sawing off the bone to cutting it away with the pliers, as the surface thus made is more smooth, as well as less bruised, and, consequently, more liable to heal well. In operating upon the smaller bones, as those of the carpus and tarsus, we are generally obliged to make free use of the gouge and chisel. In whatever manner the excision be accomplished, the invariable rule is to cut through the healthy structure; and this is applicable even when the bone is merely denuded of its periosteum, observation having shown that, when the osseous tissue is divested of its natural covering, it is either already dead, or will soon die. In excision of the long bones, the condition of the medullary canal and its contents should always be carefully scrutinized, with a view of ascertaining whether the part should be still further retrenched or not. Imperfect excision is worse than useless, as no thorough cure can take place after it without another operation. Finally, when two bones require to be removed, as, for example, in excision of the tibia and fibula, they should be sawn off upon the same level, otherwise the limb will be apt to be forced to one side, and so be rendered comparatively worthless.

Dressing.—Bleeding having been arrested, the wound is washed out with cool water thrown in with a large syringe, in order to get rid of the sawdust, which, if allowed to remain, never fails to act as a foreign substance, liable to provoke suppuration and erysipelas, if not worse consequences. Any sinuses that may exist are also pared or laid open. The edges of the wound are then approximated by the interrupted suture and adhesive plaster, aided, if necessary, by a compress and bandage. The most dependent portion of the wound, however, should always be kept patent by means of a small tent or tube, to admit of the necessary drainage. If this precaution be neglected, the result will be that the secretions, which are always more or less profuse after such an operation, will accumulate in the wound, thus not only impeding the cure, but often inducing necrosis of the bones, and affording an opportunity for the easy entrance of pus into the system.

Before the patient is returned to bed, the limb should be placed in the position in which it is to rest during the after-treatment, and kept perfectly quiet by means of appropriate apparatus. In excision of the inferior extremity osseous union is usually desired, as the limb would hardly be useful without it, and hence it will not be proper, as a general rule, to make passive motion. In the upper extremity, however, this rule is not applicable; here motion is both sought for and attained at all hazard, an anchylosed wrist, elbow, or shoulder being of little value.

The great sources of danger after excision of the bones and joints, are excessive suppuration, pyemia, and erysipelas. These accidents are to be carefully guarded against by the ordinary means, and treated upon general principles in the event of their occurrence. If the convalescence be unusually protracted, and especially if the wound be slow in healing, if sinuses form, or if there be much discharge of an unhealthy character, there will be reason to suspect that the bones have again become diseased, and that further interference will be required before a cure can finally be brought about.

CHAPTER XIX.

ANÆSTHETICS, OR THE MEANS OF AVERTING PAIN.

THE prevention of pain in surgical operations has been an object of anxious solicitude with practitioners from time immemorial, and we accordingly find that suggestions, more or less plausible, have been made at different periods with a view of meeting this important end. One of the most remarkable of these suggestions, inasmuch as it was a clear foreshadowing of the anæsthetics of the present day, occurs in the surgical writing of Theodoric, in the latter part of the thirteenth century. The means recommended by him consisted in thoroughly impregnating a sponge with a strong aqueous extract of various anodyne articles, especially opium, hemlock, hyoscyamus, lettuce, and mandragora, and then, after having been immersed for an hour in warm water, holding it to the nose until the patient fell asleep, when the operation was proceeded with. In order to rouse him when the operation was over, another sponge, dipped in vinegar, took the place of the "spongia somnifera," as the former was denominated; if this expedient failed, the juice of the root of fenugreek was freely injected into the nostrils. In India, the extract of the hemp plant, cannabis Indica, indigenous to that country, has been employed for the same purpose for ages past. Near the close of the last century, great hopes were entertained that a successful agent had at length been found in the inhalation of nitrous oxide gas, either alone, or variously combined with other vapors, but after numerous experiments, in which Sir Humphrey Davy and other eminent philosophers took an active part, the project was at length abandoned as chimerical. Some time prior to this period, Mr. Moore, of London, had suggested the possibility of diminishing pain in surgical operations, especially in amputations, by compression of the principal nerves, by means of an instrument, somewhat similar to a tourniquet, but so constructed as to touch the limb only at two points, one of the pads being regulated by a screw. The experiment was tried at St. George's Hospital, by Mr. John Hunter, upon a man whose leg was cut off below the knee on account of a large irritable ulcer of the foot, and the suffering is said to have been exceedingly slight. Very few, however, seemed inclined to repeat it, and the consequence was that it was soon given up; a result which might have been anticipated by the originator of the plan, as the instrument used for the compression was not only uncertain in its operation but productive of great uneasiness during its application.

In 1819, Mr. James Wardrop, of London, proposed to diminish the sensibility of the patient in surgical operations by means of copious venesection, and in a paper which he published on the subject in the tenth volume of the Medico-Chirurgical Transactions he cites several cases illustrative of its beneficial influence. He thought the practice particularly adapted to persons of a nervous, irritable temperament, and he recommended that it should be carried to the extent of syncope, so as completely to annul all sensation during the dissection. In one of his cases, he bled the patient, a young robust woman, to fifty ounces before he began the operation, which consisted in the extirpation of a small tumor from the orbitar plate of the frontal bone, during which she remained perfectly unconscious, expressing great surprise when she found it was over. As might have been expected, however, she remained very weak for several days after the operation, although she made a rapid recovery. I am not aware that this recommendation met with any particular favor.

The administration of the different preparations of opium for the purpose of lessening the pain of surgical operations is an old practice, highly lauded by some, and as greatly condemned by others. I was myself in the habit of employing it for many years in almost every case that fell into my hands previously to the discovery of anæsthetics; I generally preferred morphia to laudanum or opium in substance, and always gave it in full doses, either alone, or, when the patient was strong and plethoric, combined with a moderate quantity of tartrate of antimony and potassa, with a view of inducing a greater degree of relaxation and insensibility. I became very fond of the practice, and never, so far as I could determine, experienced any bad effects from it; on the contrary, I knew that it was commonly productive of great benefit, not only blunting sensibility but preventing shock, and, consequently, severe reaction.

Notwithstanding these various attempts to prevent suffering in surgical operations, no anæsthetic agent, using the term in its legitimate sense, was discovered until 1844, when Dr. Horace Wells, a dentist of Hartford, Connecticut, wishing to have a tooth extracted, rendered himself completely insensible by inhaling nitrous oxide gas; and he soon afterwards administered the same remedy to several of his patients with effects equally gratifying. Shortly after this, Dr. Wells repeated his experiments before the Medical Faculty and Students of Harvard University, at Boston, but owing to mismanagement either in the apparatus or in the gas itself, the attempt signally failed, and the only reward which he received for his pains was ridicule, which, in his case, was the more cruel, because he was a man of uncommon sensibility. Two years after this, Dr. Morton, also a dentist, who had been a pupil of Wells, resorted to the inhalation of sulphuric ether, first in his own person, and afterwards in some of his patients, until he became convinced that it might be taken not only with impunity, but with the most perfect certainty of preventing pain in any operation, however severe or protracted. Fortified with this knowledge, he applied at the Massachusetts General Hospital, at Boston, for permission to repeat his experiments upon a man who was about to undergo an operation for the removal of a tumor of the neck by Dr. John C. Warren. The result was everything that could have been desired. The next day, Morton etherized a patient for Dr. Hayward; and the news of the remedy rapidly spreading, its use soon became general, both in the United States and in Europe. In the latter country, the subject attracted perhaps even greater attention than at home, and soon led to the discovery of chloroform by Dr. Simpson, of Edinburgh, in 1847. Various other articles possess anæsthetic properties; of this description are chloride of hydrocarbon, nitrate of ethyl, aldehyde, benzin, the Dutch liquid—a compound of chlorine and olefiant gas—bisulphuret of carbon, amylene, and kerosoline; but, with the exception of the latter two, it is questionable whether any of them are sufficiently innocuous to justify their exhibition.

Practically it is of no importance to know who the discoverer of anæsthetics was; but, if we carefully inquire into the history of the matter, we cannot fail to award to Dr. Wells the credit of having made the first successful application of this class of agents for the prevention of pain during a surgical operation. Nearly fifty years previously, Sir Humphrey Davy had, it is true, employed nitrous oxide gas for the relief of a severe headache, brought on by the intoxication caused by the rapid drinking of a bottle of wine for experimental purposes, and afterwards as a means of preventing the pain of cutting a wisdom tooth; but, as every one knows, no further use was made of the remedy, until it was resumed by Dr. Wells, and applied with express reference to the production of its anæsthetic effects. He was beyond doubt the first to establish the possibility of preventing pain in surgical operations; and had his experiments at Boston not eventuated in chagrin and disappointment, he would unquestionably have pushed his researches much farther, and perhaps speedily hit upon the very articles which were afterwards found by Dr. Morton and Professor Simpson to possess such valuable properties. To both the latter gentlemen the world owes an immense debt of gratitude for having brought to light the wonderful anæsthetic effects of ether and chloroform.

It is somewhat singular that the two countries in which the anæsthetic virtues of ether and chloroform were discovered should each, respectively, prefer its own remedy; America, ether, and Great Britain chloroform. There are, however, in the United States, numerous practitioners who prefer the latter article, both in surgical and obstetrical practice, and I have myself constantly used it ever since its introduction among us in 1848, believing it to possess decided advantages over ether, although its administration unquestionably requires greater care and attention. Among the more important of these advantages are, first, the more rapid manifestation of the anæsthetic action of the remedy, the system becoming affected much sooner, as a general rule, than it does by ether; secondly, a smaller amount of laryngeal and bronchial irritation; thirdly, the more easy maintenance of the anæsthetic influence, after the system has once been fairly affected; and, lastly, the less liability to cause vomiting and other unpleasant consequences. The very odor of ether is to many persons excessively offensive, and there are very few in whom the inhalation does not produce more or less cough and vomiting. On the other hand, it certainly requires less caution in its administration, and thus far it has furnished but few deaths, whereas the mortality from chloroform already reaches about a hundred. Dr. Maddin, of Nashville, who has carefully investigated the subject, finds that most of the fatal cases of anæsthesia have occurred in minor surgery, or in operations of a comparatively trifling nature, and in which, consequently, the remedy might probably have been entirely dispensed with. For a number of these cases the dentist is accountable, nearly all the earlier and not a few also of the later having happened during the extraction of teeth, probably from the want of precaution in not sufficiently depressing the head during the operation.

It is remarkable that most of the fatal cases have happened in private practice, or in small institutions, a circumstance which would seem to show that there had been some fault in the mode of administration of the remedy. At Guy's Hospital, London, chloroform had been used in upwards of 12,000 cases before there was any serious accident; and in the war in the Crimea, according to the testimony of Mons. Flourens, it was administered more than 25,000 times without a single death. It has been asserted by the opponents of chloroform that the rate of mortality in the great operations of surgery has been essentially increased since the introduction of that article into practice, and Mr. Arnott, of London, has taken pains to collect elaborate statistics with a view of establishing the fact upon an irrefragable basis. On the other hand, the statistics of Dr. Simpson, the discoverer of the anæsthetic properties of chloroform, go to show that the number of deaths is not only not increased, but absolutely diminished. Perhaps the truth lies between these two statements. Dr. Macleod, in his Notes on the Surgery of the War in the Crimea, recently published, declares it as his conscientious belief that the use of chloroform in the British army saved many lives, and that numerous operations were performed by its assistance which could not otherwise have been attempted. It is not improbable that, if there has really been an increase in the mortality after operations since the introduction of anæsthetics, it has been owing, not to the pernicious effects of the remedy, but to the fact that surgeons have been emboldened to undertake operations in cases which were formerly regarded as unfit for the employment of the knife, and, above all, to the circumstance that of late years there has been a fearful increase of railway and other terrible accidents, many of which are necessarily fatal, no matter to what treatment they may be subjected.

I have now given chloroform for more than ten years, and during all that time no serious accident has befallen me. There was one case, however, in which I experienced much alarm; the patient was a boy, thirteen years of age, who was about to undergo an operation for the repair of his lips and cheek, which had been much mutilated by salivation. He took chloroform very badly, and had tried my patience for an unusual length of time, when, determined to make him inhale more rapidly, I began my incisions. Instantly his struggles became furious, compelling me to suspend further proceedings. Provoked at the occurrence, I requested the assistant to hold the sponge closely over the nose, while I carefully watched the pulse and respiration. Fifteen seconds had hardly elapsed, when they both ceased, the face assuming at the same time a pale, livid aspect, too clearly denotive of asphyxia. In an instant the boy was turned upon his side, and artificial respiration instituted; cold water was dashed upon his body, and a free access of cold air invited by raising the windows of the apartment. Animation was speedily re-established, and the operation proceeded with, chloroform being again given towards its close, but of course with great caution. In this case it is evident that the patient was on the very verge of dissolution; but whose fault was it? Certainly not that of the chloroform, but the manner in which it was administered.

I ascribe my good luck in the use of chloroform to the great caution with which, except in the above case, it has always been given in my practice, and to the purity of the article employed by me. During my residence at Louisville, Dr. D. D. Thomson for many years superintended the inhalation in almost every important operation that I performed, either in private or public, and when he was not present, I either gave it myself or confided the task to a trustworthy assistant.

The mortality from anæsthetics has lately been placed in a very satisfactory light by Dr. Charles Kidd. In a paper in the London Medical Times and Gazette for May, 1860, he states that, up to that period, about 125 cases of death from chloroform had occurred in Europe, 25 from ether, and several from amylene. Of 121 deaths from chloroform, 54 happened immediately before operations; 42 during the operations; and 25 after the operations. The statistics of Dr. Kidd show that the mortality from chloroform has hitherto been more than twice as large in males as in females, and that the danger from the inhalation of this substance, as had been previously ascertained by Dr. Maddin, is much greater in trivial than in large, tedious operations, the latter establishing apparently a chloroform tolerance. Of the number of deaths from chloroform and other anæsthetics in this country, we have no accurate data, but it is much less than in Europe. As an offset to the above fatal cases, it may be stated that chloroform, the use of which is unquestionably more dangerous than ether, has now been administered in hundreds of thousands of operations with perfect safety.

Anæsthetics not only prevent pain and thus save a vast amount of suffering, but by placing the patient in a passive condition give the surgeon a control over him which he could not possibly obtain in any other manner. Deprived of sensibility and consciousness, the former is virtually dead to all external impressions, and the latter is therefore enabled to conduct his dissections and other manual processes with as much ease and deliberation as if he were operating upon the cadaver. The advantages thus gained are absolutely incalculable, and he who would fully appreciate them must be able to put himself in the twofold situation of patient and surgeon, and then, in imagination, contrast their condition with that of the patient and surgeon of former times, before the discovery of anæsthetics, when the one was writhing in pain and agony during a tedious dissection, and the other had his progress incessantly interrupted by the cries and struggles of the sufferer.

The exhibition of anæsthetics is important not merely as a preventive of pain, but as a means which enables us to examine our cases more thoroughly prior to operation. Sounding for stone in the bladder, formerly a source of so much suffering, may now be performed without the slightest uneasiness, and the same is true of stricture of the urethra, diseased bones, affections of the anus and rectum, and of various other lesions. The use of anæsthetics affords immense advantages in the examination of dislocations and fractures, enabling us to handle the parts more satisfactorily than formerly, and therefore often leading to a much more certain diagnosis.

There are some operations in which the use of anæsthetics is usually regarded as inadmissible; thus, in harelip, excision of the tongue, and removal of the jaw, the patient, as a general rule, should be under the influence of these remedies only at the beginning of the operation; after the dissection has been fairly commenced, he should be sufficiently conscious to enable him to co-operate with the surgeon, otherwise the blood, passing down into the windpipe, might cause severe cough and other inconvenience, seriously embarrassing the procedure. The same remark applies to excision of the tonsils, although I have frequently removed these organs while the patient was so far under the influence of chloroform as to render him incapable of offering any resistance. Extirpation of the jaws I have repeatedly performed under similar circumstances, passing through the different stages of the operation while the person was in a state of perfect unconsciousness. Even the more delicate operations upon the eye, as the establishment of an artificial pupil, and the extraction of cataract, may be safely performed with the aid of anæsthetics; as it respects the latter, however, it should not be forgotten that the vomiting which occasionally attends their use might destroy the organ.

An advantage which has often been claimed for anæsthetics is that there is apt to be less hemorrhage during operations; I am, however, in doubt whether this is true, and, even if it were, any good that might thus accrue would be more than counterbalanced by the liability to secondary bleeding, caused apparently by a partial loss of tone in the smaller vessels, interfering with the formation of protective clots. Possibly the blood itself may be more or less at fault.

Chloroform, a terchloride of formyl, is a clear, colorless liquid, very volatile, of an agreeable, aromatic odor, of a pungent, saccharine taste, very dense, of the specific gravity of 1.497, almost insoluble in water, non-inflammable, and perfectly neutral, neither reddening nor bleaching litmus paper. It is a compound of two atoms of carbon, one of hydrogen, and three of chlorine. Various impurities are liable to be mixed up with it, especially the chlorinated pyrogenous oils, ether, and alcohol. The presence of oils is readily detected by pure, strong sulphuric acid, to which they impart a change of color, varying from yellowish to reddish brown, according to the quantity of the extraneous substances. A still more simple test consists in pouring the suspected fluid upon the hand, where, rapidly evaporating, it deposits its oily impurities, which are easily recognizable by their offensive smell. Dropped upon white paper, pure chloroform speedily disappears without leaving any stain. The existence of alcohol is detected by dropping a small quantity of chloroform into distilled water; if pure, it will retain its transparency at the bottom of the glass, whereas, if the reverse be the case, each globule will acquire a milky appearance. The presence of ether may be detected by a lighted taper or the inflammable character of the fluid. It is practically important to know that chloroform deteriorates by exposure to heat and to a strong light. The most reliable article is that prepared with methylated spirit.

Mode of Administration.—There are five principal circumstances which should be closely attended to during the exhibition of chloroform, and if this be done it will be difficult, unless the article be a bad one, or the patient have some idiosyncrasy, to produce any unpleasant effects with it. These are recumbency, an empty state of the stomach, a free play of the diaphragm, an abundance of atmospheric air, and a gradual administration.

1st. During etherization the patient may sit up with impunity, but this is not the case during the inhalation of chloroform, owing, apparently, to the greater relaxation of the muscles, and, consequently, to the greater difficulty of maintaining the circulation of the brain through the influence of the heart's action. Not only should the body be recumbent, but care should be taken to depress the head and shoulders, bringing them nearly to a level with the trunk. Lying upon the side, when this is practicable, is perhaps the safest posture of all, as the breathing will then be less likely to be interfered with by the falling back of the tongue.

2d. An empty state of the stomach is desirable for two reasons: first, because if chloroform be given soon after a hearty meal it will be almost certain to induce vomiting; and, secondly, because a crowded condition of the organ interferes materially with the movements of the diaphragm. Food must not be taken for at least four hours before the exhibition; but, on the other hand, the interval should not be too protracted, lest serious exhaustion result from the want of the necessary stimulus.

3d. Care must be taken, before the inhalation is commenced, that the patient's clothes are sufficiently loose to prevent constriction of the chest and abdomen. Any compression from this source would necessarily impede the action of the diaphragm, and might thus become a cause of mischief.

4th. The importance of having an abundance of atmospheric air during the inhalation of an article so potent as chloroform is self-evident; in etherization this is of comparatively little consequence, but in the exhibition of chloroform for surgical and obstetrical purposes, it is absolutely indispensable to the safety of the patient.

5th. The inhalation must be effected gradually, not hurriedly, time being allowed to the system to accommodate itself to the influence of the remedy, thus avoiding the shock which might otherwise result to the heart and brain. *From six to eight minutes* should usually be spent in producing the full effects of the anæsthetic.

When the patient is very feeble, or pale and timid, it will be advisable to give him, immediately before the operation, from half an ounce to an ounce of brandy; and the dose may afterwards be repeated, if the effect is obliged to be maintained for an unusual length of time, sufficient consciousness being permitted for the performance of deglutition.

The best mode of administering chloroform is to pour the fluid upon a napkin or handkerchief, previously folded into a kind of cup-shaped hollow, and held securely in the hand. Or, instead of this, a small, hollow sponge may be used. As to the various inhalers that have been devised for the purpose, they are all objectionable on account of their inconvenience and the difficulty of obtaining a sufficiency of atmospheric air. The patient having taken his place upon the table, and emptied his lungs by a deep and protracted expiration, the napkin, impregnated with a drachm of chloroform, is held over the mouth and nose, at a distance of about two inches, being gradually brought nearer and nearer until it is within half an inch, beyond which it should not be carried, the chest being at the same time regularly and powerfully distended. The pungent effect of the liquid upon the skin should be prevented by anointing the face with some protective unguent, otherwise vesication might arise. All unnecessary conversation is avoided, lest the attention of the patient should thereby be unduly distracted. The assistant having charge of the administration gives it his earnest and undivided care; wetting the napkin from time to time with the fluid, and seeing that the patient gets an abundance of air, his vigilance increasing as the effects of the medicine become more and more apparent. As soon as the sensibility is completely abolished, the operation is commenced, a return to consciousness being prevented by holding the napkin, wet with a small quantity of the vapor, occasionally before the nose, and thus the impression is maintained, steadily and cautiously, not only until the knife has fully accomplished its object, but until the principal arteries have been secured, and, in some cases, even until the dressings have been applied.

As soon as the inhalation has been fairly entered upon, one of the attendants should sedulously watch the state of the pulse, of the respiration, and of the countenance. Any sudden failure in any one of these should at once create alarm, and induce a suspension of the operation, or provision for the admission of a greater quantity of atmospheric air. I do not deem it necessary that a finger should be constantly kept upon the pulse, for the color of the face and the nature of the breathing will always sufficiently indicate the effects which the anæsthetic is exerting upon the system, and thus afford abundant opportunity for preventing any unpleasant occurrence.

The *quantity* of chloroform required during an operation, and the time during which its effects may be safely maintained, must, of course, vary according to the exigencies of each particular case. In general, from half an ounce to an ounce may be regarded as a fair average, but very frequently it takes three or even five times that amount, depending upon the severity and duration of the operation, and the susceptibility of the individual. In some instances almost an incredibly small portion answers the purpose. Children usually require comparatively little; and it is well known that women are, as a general rule, more susceptible to its influence than men. Persons exhausted by hemorrhage are very easily affected by it, owing to the rapidity of its absorption, and hence it should always be administered to them with unusual care. In obstetric practice, the effects of chloroform may be maintained, with impunity, for many hours together, and the same remark is true of severe and tedious surgical operations. Thus, in an attempt to reduce a chronic dislocation of the shoulder-joint, I kept the patient steadily under the influence of the remedy for two hours, during which time not less than twenty ounces were given.

Age is no bar to the use of anæsthetics. I have given chloroform repeatedly to very young children, and, in one instance, I administered it, with excellent effect, to an infant under two months. Old persons also bear the inhalation well. Certain diseases are usually regarded as contra-indicating the employment of anæsthetics, particularly organic lesions of the heart and brain; but, for my own part, I have never allowed any affection whatever to stand in my way, and I can really, upon general physiological principles, see no reason why they should, since, by tranquillizing the system, they effectually prevent the mental and bodily perturbation which is so apt to attend operations performed without the aid of these agents. In giving chloroform to infants and very young children, only a few drops should be poured upon the napkin at a time, and care should be taken to hold the cloth at a considerable distance from the mouth and nose, so that the fluid may enter the lungs well diluted with atmospheric air.

Effects.—The effects of chloroform upon the system may, for practical purposes, be divided into two stages, namely, that of excitement, and that of insensibility. The first begins soon after the commencement of the inhalation, and is characterized by various cries and struggles, as if the patient, feeling alarmed, were anxious to escape from the table. The face becomes flushed, the eye has a wild and staring expression, the pulse is preternaturally frequent, and the mind is incoherent; as the effects increase, the brain falls into a species of exhilaration closely akin to that of intoxication. It is now that the individual usually exhibits his peculiarities of temperament and habit. Thus, if he be of a boisterous disposition, he will be very apt to be noisy, to swear, or to fight, and to make the most violent efforts to disengage himself from the assistants. One man will laugh and joke; another will weep, or moan and sigh; the sportsman will fancy himself occupied in the pleasures of the chase; the wily craftsman in driving a good bargain; the lawyer in addressing a jury; the preacher in exhorting his congregation, and the physician in prescribing for his patient. The mind is in a dreamy, perverted condition, and whatever is most predominant at the time in thought and feeling is sure to exhibit itself in expression.

This excitement varies much both in degree and duration; in many cases it is very slight and transient, while in some it is even entirely wanting, the patient being perfectly tranquil throughout. When considerable, it is very liable to be reproduced, to a greater or less extent, as the effects of the remedy wear off, so that the individual will perhaps be quite as boisterous after the inhalation is over as he was soon after its commencement. In very nervous, excitable persons the intoxication may last for several hours, although this is uncommmon.

In the second stage, which succeeds imperceptibly to the first, the individual gradually lapses into a state of entire unconsciousness; the muscles, thoroughly relaxed, are no longer under the control of the will, the limbs retaining any position in which they may be placed; the eyelids are closed and the balls turned up, the pupils being contracted, and insensible to light; the respiration is calm and easy; and the pulse is soft and undisturbed, or, if it be at all changed, it is rather below than above the normal frequency. Feeling and intellection are suspended, and everything indicates that the patient is in a quiet and pleasant sleep, wholly unconscious of surrounding objects, and therefore completely insensible to pain. If this state be carried a little farther, coma will arise; the patient will snore as if he were apoplectic, the pulse and respiration will diminish in force and frequency, and the pupil will become notably dilated. As yet, all is safe, but a few more whiffs, and an important link in the chain of life may give way, and the patient be sent into eternity. In the administration of chloroform we should always strive to prevent coma. The most unexceptionable form of anæsthetization unquestionably is that in which there is a perfect suspension of sensibility without the complete abolition of consciousness; but it need hardly be added that it is, practically, extremely difficult to produce such a nice result in any case. In general, the patient, on recovering from the effects of the remedy, has no distinct recollection of anything that passed while he was under its influence.

The effects of chloroform seldom completely disappear under several hours. After the more characteristic symptoms have gone off, the mind will still remain somewhat bewildered, the muscles relaxed, and the feelings perverted. In some cases, especially in children, the patient, after having passed through a most severe operation, will fall into a tranquil sleep, and perhaps not wake up fully for an hour or two. In other cases, again, the effects will go off very rapidly, and the individual will not only be roused to a state of consciousness, but to severe pain. If the vapor has been inhaled largely, there will frequently be some degree of nausea or even vomiting, either during the operation, or at its close, upon the return of consciousness. Emesis is most frequent in children and in persons of a nervous, irritable temperament. Headache, although not common, is occasionally met with, and sometimes lasts for a number of hours. It is most liable to come on if the chloroform is impure.

Chloroform, inhaled to excess, sometimes produces effects which disappear only after a considerable length of time; as abolition of the sense of smell, perversion of taste, and loss of power in the bladder and rectum. In two cases, observed by Dr. Happoldt, of South Carolina, these effects did not completely wear off for two months.

Although chloroform is one of the greatest boons which a kind and beneficent Providence has bestowed upon man for the prevention and alleviation of pain, yet, like every other remedy, it is capable, when abused, or injudiciously administered, of producing the most deadly effects. These effects are those of a narcotic poison; and as they may follow, in persons of unusual susceptibility, the inhalation of the smallest quantity of the liquid, it is of the utmost importance that they should never, for a moment, be lost sight of in the use of the article. An over-dose may destroy life almost instantaneously, or death may occur at a variable period after the exhibition; sometimes after partial reaction has taken place. The phenomena indicative of danger are, stertorous respiration, a small and feeble pulse, lividity of the features, dilatation of the pupils, relaxation of the sphincters, and rapid diminution of the temperature of the body. It seems probable, although the question does not admit of positive adjudication, that these effects are mainly, if not wholly, due to the action of the carbonic acid gas contained in the chloroform primarily upon the blood and nervous centres, and secondarily upon the respiratory organs, thereby disqualifying them for the performance of their functions, death being caused by asphyxia. What corroborates this view of the subject is the fact that the danger from the inhalation of chloroform is generally in proportion to the impurity of the article, or the quantity of its pyrogenous oils, and the want of a sufficiency of atmospheric air, or the most essential constituent of this fluid, namely, oxygen, during the administration of the remedy.

The *treatment* for the relief of the poisoning consequent upon an over-dose of chloroform must be prompt and efficient; for everything depends upon the presence of mind of the surgeon and the rapidity and energy with which he applies his remedies. The first thing to be done is to desist from the further administration of the remedy; the second, to draw the tongue out of the mouth with a tenaculum, so as to lift it away from the glottis; the third, to cause a full access of cold air, by throwing open the doors and windows of the apartment, and making free use of the fan; the fourth, to dash cold water upon the body, or, still better, to pour it from a height of several feet; the fifth, to institute artificial respiration, by introducing a tube into the windpipe, and percussing the body or by blowing air into the mouth; the sixth, to stimulate the surface, especially over the spine and heart, with hot mustard water, or dilute spirits of hartshorn; the seventh, to administer an injection of turpentine; and the last, to apply galvanic electricity, passed through needles inserted in different parts of the body. As soon as the patient is able to swallow, free use is made of brandy and ammonia. These means should be employed with great diligence and regularity until it is perfectly evident that life is irrecoverably extinct.

For the minor effects of chloroform very little is necessary, beyond a discontinuance of the inhalation, sprinkling the face and chest with cold water, allowing a free access of cold air, and holding a smelling bottle near the nose, but not to it. If vomiting occur, the patient must immediately be turned upon his side—not on his abdomen, lest the action of the diaphragm be impeded—with the head inclining downwards, otherwise the contents of the stomach, as they are lazily ejected from the œsophagus and fauces, might easily descend into the larynx, and thus induce suffocation.

I cannot conclude these remarks upon the subject of anæsthetics without expressing a hope that practitioners of every description will cease to administer these remedies to females except in the presence of witnesses. The cases of the two dentists, the one of this city and the other of Montreal, which have lately created so much excitement both in and out of the profession, should serve to inculcate proper caution in this particular, without which no man's reputation and character, however pure or exalted, may altogether escape censure, if, indeed, ruin. The remarkable instance which, a few years ago, occurred at the Philadelphia Hospital, of a woman who, while under the influence of anæsthesia, went through all the movements of the sexual congress, and analogous examples reported in the medical journals, clearly show how strongly the imagination of the patient may be impressed in this way, while thus affected, and how vividly the idea may remain after the effects of the remedy have passed off. The case that occurred, not long ago, at Louisville, might have been followed by a vexatious and disgraceful law suit, if it had not fortunately been witnessed by several medical gentlemen. Practitioners should take care of their own character not less than of the lives of their patients.

Inhalation of Ether.—The inhalation of ether is best effected by means of a large hollow sponge held closely over the nose and mouth, although a folded napkin will be found to answer the purpose sufficiently well. No special attention need be paid to the admission of atmospheric air, as this fluid possesses none of the poisonous qualities of chloroform and other kindred articles. Not less than half an ounce should be poured upon the sponge at a time, and the administration should be diligently maintained until a full anæsthetic effect is produced, which usually requires a considerably longer period than in the case of chloroform. At first a short cough is generally provoked, but this soon subsides, and the system gradually lapses into a calm, quiet condition, attended with muscular relaxation, closure of the eyelids, and mental unconsciousness, followed, in many cases, by stertorous respiration.

The quantity of ether consumed in an ordinary operation is seldom less than from four to eight ounces, while in the more protracted cases twice or even thrice that amount may be necessary. Sickness and vomiting are common effects of the use of this agent, and there is also not unfrequently a great deal of headache after the patient has recovered from his unconsciousness, sometimes lasting upwards of twenty-four hours. In administering chloroform the patient always lies down; in etherization, on the contrary, he may sit up, or be recumbent, as may be most convenient to the operator, no injury resulting even from the protracted maintenance of the erect position. The inhalation too may be carried on more rapidly, and, as already stated, without any special reference to the admixture of atmospheric air, a sufficiency always entering through the sponge. Any bad effects that may arise from etherization should be treated upon the same general principles as those produced by an over-dose of chloroform. The cold douche in particular will be of much service in recalling the patient to consciousness. All the different varieties of ether possess anæsthetic properties; but the one universally preferred is the sulphuric, thoroughly washed, and divested of impurities. It is the article which Dr. Morton originally introduced to the notice of the profession under the name of letheon, or pain-destroyer, and which is now so much employed in surgical and midwifery practice in this country.

Some practitioners prefer a mixture of ether and chloroform to either of these articles alone, considering it as equally efficient, and at the same time more safe. I have myself frequently employed them in this way, and regard the combination as unobjectionable in every respect. The ordinary proportion is three parts of sulphuric ether to one of chloroform; but the quantity of either agent may be increased or diminished, according to the exigencies of the case, or the whim, fancy, or caprice of the surgeon. A mixture, composed of equal parts of chloroform and alcohol, was recommended by Dr. Snow, and is generally regarded as a very safe and efficient anæsthetic. In administering it to very young children, it may be diluted with rectified spirits, although, if proper care be taken, this is not at all essential, either to safety or convenience.

Amylene.—With amylene, as an anæsthetic agent, I have no experience. The article has seldom been employed either in Europe or in this country, and future observation must determine its merits and the degree of confidence to be reposed in it. It has been condemned by the Academy of Medicine of Paris, as too hazardous for inhalation; and it is well known that two fatal cases occurred from its exhibition in the hands of Dr. Snow, soon after he introduced the remedy to the notice of the profession in 1856, and after he had administered it successfully in one hundred and forty-three cases. He was inclined to believe that it occasioned death by inducing paralysis of the heart. It produces anæsthesia more rapidly and in smaller quantity than chloroform, at the same time that it is less liable to cause vomiting, coughing, struggling, muscular rigidity, or profound coma. The patient generally wakes up from its effects in a few minutes after the discontinuance of its use. Its odor is extremely offensive. The same care should be exercised in its exhibition as in that of chloroform.

Kerosoline.—Within the last few months kerosoline has been presented to the notice of the profession of this country, as a new anæsthetic, by Dr. E. Cutter and Professor H. J. Bigelow, of Massachusetts. Its effects are sudden and powerful, but pleasant, pervading the whole system, and diminishing the force of the pulse and respiration. In a few cases it has caused slight convulsions. It is administered in the same manner and with the same precaution as chloroform, from one to two ounces being required to produce complete insensibility.

Kerosoline is a beautiful, colorless, volatile liquid, of the specific gravity of about .634, highly inflammable, tasteless, and of a faint odor, not unlike that of chloroform, but much more readily dissipated by the air. It seems to be a very pure hydrocarbon, analogous to highly rectified naphtha, and as it does not contain any oxygen, it should be used with great care. Its entire safety as an anæsthetic has not been fully determined.

Local Anæsthesia.—Various plans have been tried for the purpose of inducing local anæsthesia, but the results have not been such as to hold out much encouragement for their practical application. When we consider the absorbent powers of the skin, it might reasonably be supposed that the endermic use of the more potent anodynes, as opium and its different preparations, aconite, belladonna, hyoscyamus, and other kindred articles, might be employed beneficially in this wise, but experience has proved that any effect of this kind that they may possess is exceedingly transient and altogether incapable of serving as a preventive of pain during the application of the knife. The employment of ice, or frigorific mixtures, recommended by Mr. James Arnott, of London, is hardly entitled to more confidence; my experience with it is, it is true, very limited, but I have seen enough of it to satisfy myself that its value has been greatly overrated by its best advocates, and it can never, except, perhaps, in the most trivial cases of injury and disease, be carried to a sufficient extent to prevent pain in surgical operations. I tried it on one occasion upon an old lady during the removal of the mammary gland; and, although the skin and subcutaneous cellular tissue were partially congealed, the ice in the latter producing a crackling noise, yet she suffered most severely, especially during the dissection of the deeper structures, where the effects of the freezing mixture had evidently not penetrated. No one can deny that, in this case, the remedy had not been carried to a sufficient extent, and yet it certainly exercised but a very feeble influence as an anæsthetic. Besides, the application is not without risk, as the part, if not carefully watched, may be frost-bitten, and thus occasion unpleasant secondary effects.

Mr. Arnott's freezing mixture consists of two parts of ice and one of common salt, the former being previously reduced to a fine powder in a canvas bag, pounded with a flat-iron. The latter should also be pulverized. The two articles are then thoroughly and quickly mixed, either with a knife, or by stirring them together in a gutta-percha or other non-conducting vessel. The mixture is now inclosed in thin gauze netting, and as soon as the action of the salt upon the ice is rendered apparent by the dripping of the brine, it is placed upon the part to be benumbed, which is held in a horizontal position during the application. The netting should occasionally be raised to watch and equalize the effect of the remedy. About a quarter of a pound of ice and half that quantity of salt suffice for an ordinary application.

The first effect of the remedy is to chill the part, but this rapidly disappears, and is succeeded by pallor of the surface and a sense of numbness. Very soon the skin is found to be notably shrunken, and to assume a deadly, tallow-like appearance, at the same time that it is rendered somewhat stiff and perfectly insensible. If the application be continued longer, the subcutaneous cellular and fatty tissues become partially congealed, as is proved by the fact that they feel hard, and crackle slightly under the finger. When the application is properly made, that is, gradually and cautiously, the netting being occasionally raised for the purpose of inspection, it is perfectly harmless and almost unattended with suffering. It is only when it is continued too long that it is likely to be productive of mischief. Ordinarily from fifteen minutes to half an hour will be required to afford the desired anæsthetic effect.

PART SECOND.

SPECIAL SURGERY;

OR,

DISEASES AND INJURIES

OF

PARTICULAR ORGANS, TEXTURES, AND REGIONS.

PART SECOND.

SPECIAL SURGERY; OR, DISEASES AND INJURIES OF PARTICULAR ORGANS, TEXTURES, AND REGIONS.

CHAPTER I.

DISEASES AND INJURIES OF THE SKIN AND CELLULO-ADIPOSE TISSUE.

SECT. I.—ERYSIPELAS.

ERYSIPELAS is so frequent and formidable an occurrence that every practitioner should be perfectly familiar with its nature and symptoms. Produced by various causes, both local and constitutional, it may exist as a primary affection, or show itself as a complication of other lesions, modifying their character, interfering with their evolution, and even, at times, entirely supplanting them. Observed from time immemorial, it is distinctly mentioned by Hippocrates, and has been a subject of particular investigation in the present century, as is evinced by the numerous papers and monographs that have been published respecting it during the last fifty years. The names and titles alone of these productions would fill many pages.

Erysipelas was at one time supposed to be peculiar to the skin and cellular tissue, but this is not the fact, modern researches having shown that it is liable to attack various other structures, particularly the mucous and serous. By dermatologists this affection is usually ranked among the exanthematous diseases, on account of the discoloration which forms so striking a feature in its symptomatology. The term by which it is commonly designated is a Greek compound, signifying a tendency to spread.

The disease is generally arranged under different heads, according to the symptoms which attend it, or the parts of the body which it implicates. Thus, there may be erysipelas of the head, face, trunk, genital organs, and extremities. The most common, as well as the most proper, division, however, is into simple, phlegmonous, and œdematous. To this some authors have added a fourth, namely, the gangrenous. To such an arrangement no valid objection can be made, provided it be borne in mind that it is altogether artificial, and that it is intended to denote merely a difference in the degree, but not in the kind, of the morbid action. There is reason to believe that this distinction has not been sufficiently heeded in practice. Erysipelas is said to be idiopathic or traumatic, according as it depends upon some constitutional vice, or upon external injury.

The malady occurs at all periods of life, and in both *sexes*, but in what ratio has not been ascertained. The idiopathic variety is perhaps most common in women, the traumatic in men, owing to the greater liability of the latter to all kinds of injury.

There are no facts to show that *temperament* exerts any influence in the production of this disease. Bilious, or bilio-sanguineous, and nervous, irritable persons are said to be most prone to it; but in what proportion, or for what reason, remains to be determined. The malady is more frequent, at least in America, in the latter part of autumn, in winter, and early in the spring than at any other season of the year, not a day of which, however, is anywhere exempt from its invasion in either of its two forms. Locality, doubtless, exerts an important influence in its causation; it is well known that it is particularly liable to occur in the narrow, crowded, and filthy streets of large cities, in the confined and ill-ventilated wards of hospitals, and in marshy, malarious districts. The effect of occupation in producing erysipelas has not been determined; but there is no question that cooks, blacksmiths, foundrymen, and persons habitually exposed to dry heat are particularly obnoxious to its attacks.

No *region* of the body is exempt from this affection, though some are more liable to it than others. The idiopathic form is most frequent in the face, scalp, neck, and trunk, while the traumatic appears to be most common in the extremities, particularly the inferior. It has been observed by most writers that the eyelids, nose, and forehead are especially prone to be attacked; a fact for which it is impossible, in the existing state of the science, to assign any satisfactory reason. Old, decrepit subjects, and persons worn out by intemperance and disease, often suffer from erysipelas of the scrotum, the vulva, feet, and legs. In infants a very common seat of the disease is the lower part of the abdomen, around the umbilicus. Injuries of the scalp, tendons, and aponeuroses frequently give rise to erysipelas, and are liable, in consequence, to be followed, in many cases, by the worst results.

Erysipelas occasionally assumes an *epidemic* type. Hippocrates had already observed this fact. During the middle ages a gangrenous erysipelas repeatedly ravaged France, where, from its excessive violence, the disease was called the plague of fire. In times of war erysipelas has occasionally prevailed as an endemic in camps, barracks, hospitals, and prisons. In modern times it has been observed in both of these forms in various localities. Dr. Gregory expresses the belief that there is not a single hospital in London which has not, occasionally, been visited by the endemic variety of the disease. At St. George's Hospital, in that city, he has repeatedly seen erysipelas so prevalent that all important surgical operations were obliged to be postponed for fear of the supervention of the malady. The inmates of the Hôtel-Dieu, of Paris, are frequently assailed in this way, and the mortality thence arising is said to be quite great. Calmiel states that there are periods when erysipelas prevails so extensively in the lunatic asylums of the French metropolis that the physicians of those institutions are compelled to suspend all treatment by counter-irritants, as blisters, setons, issues, and moxas, because it is almost certain to be followed by an outbreak of this affection. Velpeau describes an epidemic erysipelas which prevailed at La Pitié in 1831. In 1844, '5, and '6, the disease was so common in the Louisville Hospital, and also throughout the city of Louisville, that I was obliged, on numerous occasions, to postpone the performance of all operations in which delay was admissible, for fear of giving rise to it. Such was the tendency, at that period, to its occurrence, that the most trivial incision, the slightest puncture, and the most insignificant scratch were almost sure to be followed by an attack. For a long time we were obliged, in consequence of this proclivity, to refrain from the application of blisters and leeches, venesection, the introduction of setons, and the establishment of issues. Chancres, buboes, and common ulcers were often invaded in the same manner. But the demic was not confined to that city; it prevailed more or less extensively in different sections of the Union, and carried off an immense number of all classes of people. In many localities there was a marked connection between the affection and puerperal peritonitis, the latter of which proved very fatal.

The question as to the *contagiousness* of this disease is not fully settled. Much may be said both against and in favor of such a view. My own opinion, founded upon considerable experience, is that the affection, at times, possesses such a character. It is very well known that it is inoculable. Thus, a sponge impregnated with the matter of an erysipelatous sore will very readily communicate the disease to an ulcer or an abraded surface in a sound person, and the same thing is true of poultices, salves, and other dressings. Facts which show that the nurses and friends of individuals affected with erysipelas often contract the disease are of frequent occurrence. In this way whole families are sometimes cut down. A gentleman in Davies County, Kentucky, in 1852, lost his only son by this disease. A cousin and a female acquaintance who attended on him soon became ill with it, and both died; it then spread to other members of the family, producing serious ravages before it was finally arrested. In 1846, when erysipelas reigned as an epidemic at Louisville, a man was received into the Louisville Hospital with an ulcerated bubo, and about the same time a woman, who had been his mistress, was also admitted with the prevailing distemper. In consequence of an inability to obtain a female nurse, the man was permitted to attend upon her in that capacity. He soon cohabited with her; in a few days he became excessively ill, the sore in the groin assumed an erysipelatous aspect, and in less than a week from the time of his admission he died from the effects of the malady. In the wards of hospitals erysipelas often spreads from one person to another, and in private practice the disease, there is reason to believe, is occasionally carried by the physician from one house to another. In this way it is no doubt sometimes communicated by the accoucheur to parturient females.

Causes.—The causes of erysipelas are too numerous and diversified to admit of any very definite specification. As a general rule, it may be assumed that whatever has a tendency to disorder the digestive, hepatic, or, in short, any other important function, is capable of producing the disease. So true is this that there is seldom, if ever, a case of the complaint in which such derangement does not play a more or less conspicuous part. The fact is important, as leading to valuable therapeutic considerations. Certain articles of diet either predispose to or induce the malady. Thus, there are some persons who can never eat shell-fish or particular kinds of fruits, as strawberries, nuts, and similar substances, without suffering an attack. The retention of vitiated secretions and undigested food in the alimentary canal often leads to similar results. Derangement of the uterine function, suppression of the cutaneous perspiration, great mental excitement, the habitual use of ardent spirits, loss of sleep, hard study, inordinate sexual indulgence, and whatever else has a tendency to weaken the corporeal faculties, may be enumerated as so many causes of the disease. A vitiated state of the atmosphere, as is witnessed in hospitals and other charities, often powerfully predisposes to its attacks and its continuance.

Erysipelas frequently supervenes upon wounds, both accidental and artificial, interfering with the healing process, and, at times, seriously compromising both part and system. The period at which this occurs varies from twenty-four hours to several days, according to the nature and extent of the lesion, the presence or absence of complications, the habits of the patient, the condition of the system, and the state of the atmosphere. Lacerated, punctured, gunshot, and poisoned wounds are much more liable to be assailed in this [illegible] than incised wounds, though the latter are by no means exempt from it, especially if they involve the scalp, hands, or feet, or if they affect old, intemperate, or debilitated individuals.

When the disease is epidemic, it often shows itself within a very short time after the reception of an injury, however slight or insignificant. Under such circumstances, indeed, I have, as already stated, known it to follow upon the most trifling wound, scratch, or puncture, as a leech-bite, venesection, vaccination, or the application of a blister. Fractures, dislocations, sprains, contusions, and various other injuries not unfrequently give rise to it. Ulcers, whether common or specific, are often invaded by it, especially when the patients are of a broken-down constitution. Lying-in females are, in certain conditions of the atmosphere, particularly prone to suffer from erysipelas of the uterus and pelvic veins.

Finally, erysipelas frequently ingrafts itself upon other diseases. During the winter of 1857, when the malady was endemic in this city, a number of instances occurred where it supervened upon measles, scarlatina, and typhoid fever. During an outbreak of epidemic erysipelas in Louisville, in 1844, '5, and '6, every case of disease that was admitted into the public hospital of that city received its peculiar impress, and wore, for a time, its peculiar livery. When the affection was raging at its fullest height in the institution, many of the patients who were convalescing from other maladies were suddenly seized with diarrhœa, pneumonia, and bronchitis, over which the usual remedies exercised no control, and which generally proved fatal in a few days.

When erysipelas supervenes upon wounds, its approach is usually denoted by an arrest of the adhesive process, by a tensive, burning sensation in the affected part, by a discharge of thin, sanious matter, or an entire suspension of secretion, and by an œdematous appearance of the surrounding structures. Finally, the characteristic blush occurs, and gradually diffusing itself often spreads over a considerable extent of surface.

When erysipelas seizes upon ulcers, as it may do at any time, whether they be benign or malignant, simple or specific, the local symptoms closely resemble those which characterize the complaint when it follows upon wounds and contusions. The granulations, if any exist, assume a pale, glossy, unhealthy aspect, the pus is replaced by a thin, ichorous fluid, the part is rendered uncommonly painful, and the edges of the sore, along with the adjacent surface, exhibit a reddish, œdematous appearance. In chancres and dissection wounds the presence of the malady is indicated by reddish, tender lines, formed by superficial lymphatic vessels, generally extending as high up as the neighboring ganglions, which, in turn, become swollen and exquisitely painful. The morbid action may, in both cases, be simple or phlegmonous, and is almost always dependent upon derangement of the digestive organs, or the suppression of some habitual discharge.

Erysipelas, consequent upon fractures and dislocations, generally displays itself within the first forty-eight hours after the reception of the injury, and often spreads very rapidly over a large extent of surface, as the greater portion of a limb, one side of the trunk, or the whole scalp and face. The accident is particularly liable to supervene upon the compound forms of these lesions, and is always to be viewed with distrust, as it not unfrequently compromises the patient's recovery. Erysipelas of the scalp, caused by wounds or fracture of the skull, generally appears from the second to the third day, and often proves dangerous by its extension to the brain and its envelops, through the intervascular communications between the pericranium and the dura mater. Such cases always demand the greatest vigilance on the part of the practitioner.

Varieties.—Erysipelas occurs under several varieties of form, as the simple, phlegmonous, and œdematous, each of which merits brief attention. To this division may be added erratic erysipelas, so called from its disposition to wander from one part to another.

The term *simple* is employed to designate that form of the disease which is confined exclusively to the skin. It manifests itself in a bright, vivid, almost scarlet discoloration of the skin, a pungent, smarting, or burning pain, and a sense of stiffness, with, perhaps, here and there a little vesicle, not larger than the head of a pin, and filled with a serous fluid. The swelling is very slight, and, unless the extent of disease is considerable, there is no particular constitutional disturbance. The attack is usually of short duration, and the subsidence of the local disease is always followed by a furfuraceous desquamation of the epidermis.

Phlegmonous erysipelas is a much more serious lesion than the simple, all the symptoms existing in a higher degree, and the disease often terminating in extensive suppuration, abscess, and even gangrene. The discoloration varies from scarlet to deep purple; there is extensive swelling; vesication soon arises; and the pain is of a violent, burning, tensive, and throbbing character, the part feeling heavy, stiff, numb, and as if it were on fire. The inflammation extends deeply into the different tissues, affecting skin, cellular substance, muscle, and, in short, everything that comes in its way. As it progresses, suppuration takes place, leading to the formation of extensive abscesses, and the destruction of large portions of the cellular and adipose tissues. If the morbid action be very intense, mortification will be apt to arise, its approach being indicated by the development of large blebs, filled with bloody or muddy serum, and by a dark, livid, brownish, or ash-colored appearance of the skin. The constitution sympathizes early and deeply, the symptoms being at first of a sthenic character, but soon becoming typhoid.

The *œdematous* variety depends entirely upon accidental circumstances, its name being derived from the circumstance of the parts being infiltrated with serosity, and, consequently, pitting under pressure. It is most commonly met with in the eyelids, scrotum, prepuce, vulva, and inferior extremities, in persons who are debilitated by previous disease, or who naturally possess a feeble constitution. The swelling is often considerable, but the discoloration and pain are comparatively trivial. The diseased surface has a glossy, distended appearance, and retains the mark of the finger for some time after it has been withdrawn. The inflammation is attended by constitutional disorder, generally of a typhoid character, and is apt to terminate in mortification rather than in abscess, though the latter is often present in the more severe cases.

Erratic erysipelas is characterized, as the name imports, by a disposition to extend from one point to another; it is most commonly met with on the face and forehead, from which it frequently spreads, on the one hand, to the hairy scalp, and, on the other, to the neck and ears. I remember a case of this form of erysipelas which, commencing on the left [illegible], extended over the whole trunk. The disease is generally superficial, and is characterized by an erythematous appearance of the surface, with pungent pain, but little swelling.

If a *dissection* be made of a part in a case of erysipelas, it will exhibit various appearances, according to the amount of the disease, which [illegible] the milder grades, there will [illegible] be some degree of [illegible] of the [illegible] unusual distension of the [illegible] and slight effusion of serum, or of serum and lymph, in the [illegible] [illegible] [illegible] there is generally [illegible] the lymph has a [illegible] and [illegible] [illegible] mixture of flour and water [illegible] tissue is converted into [illegible] extensively separated from each other. In a case which occurred in the Louisville Hospital in 1846, during the prevalence of epidemic erysipelas, the abscess reached from the hip to the ankle, extensively detaching the muscles from each other and from the bones, which might have been lifted almost bodily from the diseased mass, so completely were they severed from their connections. Pure blood is sometimes extravasated in considerable quantity; and the matter, which varies much in its color and consistence, is often excessively offensive. Metastatic abscesses are occasionally found in the internal viscera, and effusions in the serous cavities.

An epidemic erysipelas, of a very singular character, prevailed in various sections of this country, from 1842 to 1847, its first appearance having been noticed in Vermont and New Hampshire. It had previously shown itself in Canada, and soon after it broke out in the southwestern States, where, as well as in other parts, it proved exceedingly fatal. In Louisville, where I then resided, it prevailed for several years, and afforded me an excellent opportunity of studying its character. It usually began in the throat and fauces, or simultaneously in these parts and upon the cranio-facial region, in the form of a deep red, glossy, œdematous swelling, which gradually extended until it involved the whole of the neighboring structures, the countenance being generally distorted in the most hideous manner, so that the patient could hardly be recognized even by his most intimate acquaintances. The tongue, uvula, and tonsils were enormously swollen, deglutition and breathing were extremely difficult, and death was often produced by suffocation. Delirium and excessive prostration were early and prominent symptoms, and many of the cases perished within the first five days. The disease remained generally confined to the parts originally affected. If the patient survived any time, profuse suppuration, and sometimes even extensive sloughing, occurred; abscesses formed in various regions of the body; and, after much suffering, the patient either recovered, or died from exhaustion. In some of the persons whom I attended there was extensive ulceration of the tonsils and arches of the palate; and, in several, complete destruction of the parotid gland of one side. In one case, almost the whole of the occipital bone was stripped of its pericranium. Dissection disclosed deep engorgement of the lungs, accompanied, in many cases, by inflammation of the bronchial tubes, and even of the pulmonary parenchyma, and by effusion of serum, or of serum and pus, in the pleura and arachnoid sac. The abdominal and pelvic viscera were generally sound, except in lying-in females, who usually exhibited high evidence of peritonitis, metritis, and phlebitis. In one instance, which occurred quite early in the epidemic, the immediate cause of death was a large metastatic abscess in the left lung, the erysipelas being seated in the corresponding leg.

The disease which I have thus briefly described was generally known in the west under the name of "black-tongue," "swelled head," or "erysipelatous fever." It seldom attacked any one under fifteen years, but from that period up it was indiscriminate in its selection of subjects. Females seemed to suffer quite as frequently as men. The poor and the intemperate were its most common victims.

Constitutional Symptoms.—Whatever form it may assume, erysipelas is usually preceded by symptoms denotive of general indisposition, such as a feeling of *malaise*, or discomfort, creeping, chilly sensations, lassitude, pain in the head and limbs, impaired appetite, and an indisposition to exertion. After continuing in this state for a period varying from twenty-four to thirty-six hours, the disease declares itself in a more open manner. The patient is now suddenly seized with shivering, or violent rigors, followed by, or alternating with, excessive heat, and accompanied by severe cephalalgia, nausea, intense thirst, restlessness, and a great sense of muscular prostration. The tongue is dry and coated, the skin hot, the pulse strong and frequent, the urine high-colored and scanty. As the disease progresses, the system becomes more and more exhausted, the mind wanders, and the case soon assumes a typhoid character. Or, typhoid symptoms may be present almost from the very commencement, especially if the patient be old, or depressed by previous suffering. In the milder forms of erysipelas, there is often very little, if any, constitutional disturbance.

If blood be drawn during the progess of the disease, it will generally be found to exhibit a sizy appearance. Sometimes it is deeply buffed and even cupped. What internal, or intrinsic changes, the mass of blood undergoes in this affection has not been satisfactorily determined.

Diagnosis.—Erysipelas is generally so well marked as to render it impossible to confound it with any other disease. The only form which is liable to cause error of diagnosis is the simple, which may be mistaken for erythema, which it certainly very much resembles. The signs of discrimination are, the peculiar character of the pain, which is sharp, pungent, and smarting in erysipelas, and almost absent in erythema; the deeper redness in the former than in the latter, and the tendency also to the evolution of vesicles, which does not exist in erythema.

Pathology.—The pathology of erysipelas has been a fruitful subject of discussion almost from time immemorial, and yet, notwithstanding all that has been said and written about it, it is still involved in impenetrable obscurity. How it is induced, what is its seat, or where it originates, are points concerning which we are wholly ignorant. We only know that it has a peculiar predilection for the dermoid and cellular tissues, and that it is usually, if not invariably, connected with disorder of the general system, affecting, probably, both solids and fluids. So thoroughly am I convinced of the latter fact, that I do not believe it would be possible for erysipelas ever to appear in a perfectly sound individual. If this be true, as I think multiplied and carefully conducted observation authorizes me to affirm, then derangement of the general health, especially as displayed in a vitiated condition of the digestive organs, must be regarded as a most important element in the pathology of this affection, and one which must exert a marked influence upon our curative agents. The opportunities constantly afforded the surgeon, in cases of accidents and operations, of testing this point, peculiarly qualify him for pronouncing upon the question. I am not now, of course, speaking of epidemic erysipelas, to which every one is more or less liable, but of the ordinary form, the development of which, as is well known, is so much influenced by intrinsic and extraneous circumstances, as the health and habits of the patient, his residence, the nature of his diet, and the state of his mind. When a person is intemperate, breathes a foul air, eats bad food, or has a troubled mind, the most trivial injury, as the merest prick of the finger, is often followed by a fatal attack of the disease, whereas another, although severely hurt but enjoying better health, will, perhaps, escape entirely, or suffer only in a slight degree. The surgeon, aware of this circumstance, constantly acts upon it in practice, making it a rule never to perform any serious operation until he has put his patient in a proper condition for it by the rectification of his secretions and the improvement of his general health.

Erysipelas has sometimes been regarded as consisting essentially in a bad form of capillary phlebitis, it being alleged that the smaller veins are generally found to be involved in the disease, as is shown by the inflamed condition of their coats, and the existence, in their interior, of various kinds of substances, as lymph, pus, and coagulated blood. Such changes undoubtedly occur, to a greater or less extent, in all severe cases of the malady; but they occur, not as a cause, but as a consequence of the morbid action. Other pathologists, again, consider erysipelas as being essentially an affection of the lymphatics; and, lastly, there is another class who look upon it as originating in both these vessels. All these views, however, amount to nothing but conjecture, their truth or falsity remaining to be established.

Prognosis.—The prognosis in erysipelas is influenced by the character, extent, and seat of the morbid action, by the age and habits of the patient, and by the absence or presence of complications. Phlegmonous erysipelas, other things being equal, is generally more dangerous than the simple or œdematous, as it is more liable to end in extensive suppuration, gangrene, and metastatic abscesses. A simple erysipelas, however, if of great extent, is hardly less dangerous to life than a phlegmonous one, the shock to the nervous system being nearly as severe as in a superficial but extensive burn, which often kills on this account. When the disease attacks the head it is always more to be dreaded than when it makes its appearance upon other parts of the surface. Infants, young children, and old persons bear the disease badly; as do also the habitually intemperate. Erysipelas is particularly dangerous when it occurs during the progress of other maladies, as measles, scarlatina, and typhoid fever. Epidemic erysipelas is always a more destructive disease than a sporadic one, the malady, under such circumstances, impressing itself with peculiar force upon the constitution. Traumatic erysipelas often kills in a surprisingly short time. In the summer of 1856, I attended a young butcher, who died in less than three days from a violent attack of this disease of the hand and arm, brought on by a punctured wound inflicted by a hook used for hanging meat upon in the market-house.

TREATMENT.

Erysipelas being capable of being developed by such a variety of circumstances necessarily demands a corresponding variety of treatment. Experience long ago showed that remedies which afford relief in one case are productive of no benefit in another, and hence it is all important, in every instance, that our curative measures should be based, if possible, upon a correct appreciation of the nature of the exciting causes. If the practitioner should attempt to combat it upon any other principle, he will find himself sadly mistaken.

The treatment of this disease may conveniently be divided into constitutional and local, and it is hardly necessary to add that each head embraces a great variety of means, which it will be necessary to pass briefly in review. The constitutional remedies upon which our reliance is mainly to be placed are, bloodletting, emetics, purgatives, diaphoretics, mercurials, and anodynes.

Bloodletting is not applicable in all cases of erysipelas; on the contrary, there are some in which it inevitably proves mischievous, if not fatal, by augmenting the debility of the system, already, perhaps, greatly depressed by the violence of the morbid action. The circumstances which, in my judgment, render a resort to the lancet proper in this complaint are, first, a strong, full, and frequent pulse; secondly, a robust and vigorous state of the system; thirdly, excessive pain and tension of the parts; and, lastly, the involvement, threatened or actual, of important internal organs, as the brain, lungs, and throat. The amount of blood to be abstracted must depend upon the effects which the operation exerts upon the system. One moderately copious bleeding, performed early in the disease, will usually be sufficient, and will answer a much better purpose than two or three small ones. It should be borne in mind that venesection should never be carried as far in epidemic as in sporadic erysipelas, and in old, sickly, or intemperate persons, as in the young, robust, and plethoric. In the epidemic erysipelas which prevailed so extensively a few years ago in various sections of the United States, the abstraction of blood was generally borne very badly, and many lives were lost by its injudicious employment. In the Louisville Hospital not a single patient recovered that was bled for this disease. In erysipelas supervening upon capital operations and severe accidents, as compound fractures and dislocations, wounds, and contusions, proper allowance must be made by the practitioner for the effects of shock and loss of blood, and the resulting suppurative discharges. Children affected with erysipelas rarely, if ever, require bleeding in any form.

Great contrariety of opinion has prevailed among writers respecting the employment of *emetics* in this disorder, some having pointedly condemned them, while others have expressed themselves most warmly in their favor. In the hands of Desault and his disciples the greatest benefit seems to have attended their exhibition. The probability is that here, as elsewhere, in similar cases, the truth lies between the two extremes; for it can hardly be supposed that a class of remedies of such acknowledged potency in many cutaneous affections should be altogether useless in erysipelas. The cases in which, according to my observation, emetics are mainly indicated are those in which there is marked biliary derangement, along with nausea, loathing of food, headache, pain in the back and limbs, great restlessness, and dryness of the surface. These symptoms, so distressing to the poor sufferer, are often promptly relieved by full emesis, excited by ipecacuanha and tartrate of antimony and potassa, ipecacuanha alone, or salt and mustard, and encouraged by the free use of tepid drinks. In protracted cases, and in the erratic form of the malady, attended with derangement of the digestive organs, gentle emetics often operate like a charm in breaking up the chain of morbid action.

When it is remembered that this disease is often directly dependent upon an overloaded state of the bowels, the presence of irritating ingesta, and the suppression of the secretions of the digestive organs, it is not difficult to discover a reason for the high estimate which has always been placed upon the administration of *purgatives*. Indeed, it would be hard to find a case in which it would be altogether improper to dispense with them. In my own practice I have always derived from them the most signal benefit, especially in the earlier stages of the complaint, although there is no period in which they can perhaps be entirely omitted with safety. The articles upon which I mainly rely are calomel, rhubarb, and compound extract of colocynth, variously combined, and given in sufficient quantity to produce two or three free and consistent motions. Sometimes the addition of a little tartar emetic or ipecacuanha proves beneficial, especially when there is an arid state of the skin and mouth; while occasionally they may be advantageously replaced by others, as castor oil and spirits of turpentine, oil alone, senna, or Epsom salts. When there are nausea and headache, with a highly coated tongue, the best cathartic, in general, is calomel and ipecacuanha, in the proportion of about fifteen grains of the former to two grains of the latter, followed, if necessary, in six or eight hours, by a stimulating enema, or a dose of sulphate of magnesia. When the bowels have been once thoroughly evacuated, a moderate passage should daily be induced by some mild laxative, as blue mass and rhubarb, Seidlitz powder, or colocynth and hyoscyamus.

Diaphoretics constitute a valuable class of remedial agents in the treatment of this affection, and can seldom be entirely dispensed with, as there are few cases in which the cutaneous function is not more or less interrupted, perverted, or suspended. After proper depletion by the lancet and purgatives, or, at all events, thorough evacuation of the bowels, and the restoration of the secretions of the digestive organs, the administration of medicines calculated to act upon the skin often proves eminently serviceable. Among the best of this group of articles are Dover's powder and the salts of antimony and morphia, aided by tepid sponging, or, when the patient's strength admits of it, the warm bath. In children and debilitated persons, the spirit of Mindererus and wine of ipecacuanha may be advantageously resorted to. Aconite, in doses of three drops of the tincture, every two, three, or four hours, generally answers an excellent purpose, especially when there is a hot and arid condition of the surface, and inordinate excitement of the heart. The same is true of veratrum.

There are few cases of erysipelas, even of the milder grades, in which the use of *anodynes* is not indicated, either for the purpose of allaying pain, or of inducing sleep. When the malady occupies, as it not unfrequently does, an unusual extent of surface, the system is very apt to suffer in the same manner as in severe burns and scalds, and requires, at a very early stage of the complaint, the employment of soothing measures. The remedy, which is commonly one of the salts of morphia, is administered upon the same principles as in other inflammatory affections, either by itself, or in union with other articles, especially diaphoretics, in quantities proportioned to the exigencies of each particular case. As a general rule, the object is best attained by a full dose, repeated once or twice in the twenty-four hours. To an adult, laboring under great pain and restlessness, provided there is no cephalic trouble, not less than half a grain of morphia should be given at a time. Thus administered, the effects of the remedy are much more decided and beneficial than when it is exhibited in smaller doses, as is too often the case with practitioners, not only in this, but in other inflammatory maladies. Delirium, or cerebral disorder, does not necessarily contra-indicate the use of anodynes; on the contrary, persons so affected are often immensely benefited in a short time by their judicious exhibition. To no class of patients is this remark more applicable than to habitual inebriates, and individuals worn out by previous disease, loss of blood, protracted drainage of the system, or constitutional irritation. Such persons absolutely require, at an early period, and in every stage of the malady, the use of anodynes in large doses, in order to prevent exhaustion, and afford time and opportunity for the more efficient action of other remedies.

Mercurials are sometimes usefully exhibited in this disease. They are particularly valuable in the erratic form of erysipelas, and when there is a tendency in the malady to linger in the system, after its principal force has been exploded, but when it is still disposed, as it were, to dispute with the practitioner every inch of its possessions. In such cases, they occasionally act like a charm, even when they are not carried to the extent of ptyalism, which, however, is often necessary, before the disorder will relinquish its grasp. During the epidemic erysipelas which prevailed in Louisville and its vicinity in 1844, '5 and '6, I treated quite a number of cases upon this plan, with the most happy results, although now and then a patient was lost, even after the establishment of slight salivation. Mercurials should be most scrupulously avoided in erysipelas attended with a low, typhoid state of the system in old, worn-out subjects, and in persons exhausted by intemperance and dissipation. The best form of exhibition, when the remedy is indicated, is calomel with a small quantity of opium and ipecacuanha, or Dover's powder, to restrain its action on the bowels and allay nervous irritation. In urgent cases two grains of the metal may be given to an adult every four or six hours, combined with half a grain of the anodyne. When a less rapid impression is desired, blue mass, iodide of mercury, or the gray powder may be used. In whatever form or manner the remedy be given, its effects should be most carefully watched, and they should never be carried beyond the limits of the slightest possible ptyalism.

The late Professor John K. Mitchell informed me that he had, for years past, derived more benefit, in this disease, from the use of *iodide of potassium* than from any other remedy. His plan was, after gentle alvine evacuation, to begin at once with the article, giving it, largely diluted with water, every two or three hours, in doses of from five to ten grains, until the attack was arrested, which, it would seem, usually happened in a few days. In the few trials which I have made of this remedy, I have witnessed no material benefit, and in several cases I was obliged to suspend it at an early period, on account of its disagreeing with the stomach.

Stimulants and tonics are required when there is, as occasionally happens even in the early stage of the disease, a tendency to excessive prostration. A hard, dry, and brownish tongue, sordes on the teeth, a small, feeble, and frequent pulse, twitching of the muscles, coolness of the surface, and copious sweats, with or without delirium, clearly indicate the necessity of the employment of this class of remedies, which are sometimes alone capable of arresting the disease and of establishing convalescence. The articles ordinarily resorted to for this purpose are ammonia, wine, brandy, porter, or ale, along with quinine, or some of the mineral acids, and nourishing broths. Of all these substances, the best by far is brandy, in the form of milk punch, julep, or toddy. Quinine may also generally be used with great benefit, and there is no internal remedy which I so frequently employ in the latter stages of erysipelas, or in cases demanding a decided tonic. The proper dose is from three to five grains every four, six, or eight hours.

Lately, the tincture of the *chloride of iron* has been much employed by practitioners of this city, and apparently with very gratifying results, in doses varying from fifteen to thirty drops, from three to six times in the twenty-four hours. It is particularly serviceable where a tonic effect is indicated, and is, therefore, best adapted to feeble, delicate subjects, laboring under a deficiency of hematosin, or the coloring matter of the blood. Like iodide of potassium, however, and some other articles, it is apt to disagree with the stomach, and should, therefore, be given with some degree of caution, the best plan being to suspend it in some pretty thick demulcent fluid.

Throughout the whole treatment, the greatest attention should be paid to the ventilation and temperature of the patient's apartment; the body and bedclothes should be daily changed, and the cutaneous surface should be frequently sponged with tepid salt water, or some slightly alkaline solution. As disinfectants, free use is made of the chlorides. As soon as his strength admits of it, the patient should take gentle exercise in the open air, and, if possible, sleep in another apartment.

All *topical* remedies in the treatment of this disease are to be regarded rather as auxiliary than as curative agents. Looking upon the cutaneous eruption merely as a local manifestation of a constitutional disorder, the philosophical practitioner will place his reliance mainly upon internal means, and consider all external ones as of secondary moment. Nevertheless, it would be wrong, even in many of the milder cases, wholly to neglect these, since experience has abundantly attested their utility. A vast variety of applications, many of them of the most opposite character, have been recommended with this object, as warm and cold, dry and moist, astringent and relaxing, stimulating, vesicant, and anodyne. It would seem, indeed, as if almost every article of the materia medica had been called into requisition, as if to show what little confidence, as a general rule, is to be placed in their efficacy.

At the head of the list of local remedies may be placed *leeching*, concerning the efficacy of which, however, practitioners are still divided in opinion. My own belief is that it may often be employed with great advantage, though, in general, it is, I think, entirely unnecessary. The fact that the operation is occasionally followed by erysipelas does not, in my judgment, prove that it may not at times be beneficial. It is only in rare cases, and under peculiar circumstances, as when the patient is of a very irritable habit, or the leeches are sickly, that such a result is at all likely to occur. Against such a contingency the judicious practitioner will, of course, always guard. The use of the remedy is particularly indicated in erysipelas of the throat and larynx, the scalp, eyelids, vulva, toes, and fingers. The number of leeches must vary according to circumstances, as the intensity of the morbid action and the vigor of the patient; and the flow of blood should always be encouraged by warm fomentations until the desired quantity is obtained.

One of the great topical remedies at the present day for the cure of erysipelas is *iodine*, either in the form of tincture or solution. I generally give the preference to the former, diluted with an equal quantity of alcohol, and laid on by means of a large camel-hair pencil, the end of a stiff feather, or a soft cloth mop, until the surface is of a yellowish, brownish, or mahogany color. The application should embrace a small portion of the sound skin, and should be repeated at least twice, if not thrice, in the twenty-four hours. In the milder grades of erysipelas a single application will occasionally suffice for a cure; while in the more aggravated a considerable number may be required before the disease is finally discussed. The remedy is sometimes productive of severe pain, especially in nervous, irritable, and thin-skinned persons, which may persist for several hours, and which hardly anything, save time, will allay. To obviate this occurrence, the first application should always be very light; if no inconvenience arise, the medicine may afterwards be used more freely, and may even, in some instances, be advantageously carried to the extent of vesication. If, notwithstanding this precaution, the pain be very severe, the part should be freely sponged with a weak solution of iodide of potassium, and covered with a starch poultice.

I have employed the tincture of iodine in the form and manner here indicated for many years, both in the sporadic and the epidemic varieties of the disorder, and can confidently assert that I have derived more benefit from it than from any other article of which I have any knowledge. Resorted to in the early stage of the disease, it rarely fails promptly to relieve the pain and tension, which form such prominent features in the symptomatology of the affection, and which add so greatly to the patient's suffering. The beneficial effects of the remedy appear to be due to its stimulant and sorbefacient properties, which rapidly promote the removal of effused fluids, and assist in checking morbid action. When applied very freely it occasionally vesicates, and is thus instrumental in unloading the cutaneous capillaries. Doubtless, it also acts advantageously upon the blood and its vessels, indisposing them to further effusion.

Another highly valuable agent for the cure of this disease is the *nitrate of silver*, employed either in substance, or in strong solution. It is applied either directly to the affected surface, or a belt is drawn around it upon the healthy skin, to prevent its further spread, which constitutes such a distinguishing trait in its symptomatology. I commonly prefer the former method, using the solid nitrate instead of the solution, so strongly recommended by Mr. Higginbottom. In order to apply this substance properly, it is necessary, as a preliminary step, that the surface should be divested of all greasy and perspirable matter, otherwise it will refuse to unite with the epidermis, and so prove, in great measure, inert. The part should then be gently moistened with cistern water, when the caustic is passed firmly and efficiently over it until the whole has been thoroughly touched. Thus employed, the application speedily blackens the epidermis and coagulates its albuminous matter, thereby forming an excellent defence to the delicate tissues beneath. When used more freely it generally vesicates, elevating the scarf-skin into tolerably large blisters. Mr. Higginbottom applies a strong solution of the nitrate of silver, consisting of three drachms of the salt to the ounce of water, with the addition of a small quantity of nitric acid. I have no experience with the remedy in this form. The probability is that nitrate of silver produces its beneficial effects very much in the same manner as the tincture of iodine, changing the tone of the capillary vessels and promoting the absorption of effused fluids, besides serving as a direct defence to the cutaneous surface by its union with the albuminous matter of the superficial layer of the skin.

Professor Gilbert, of this city, has been in the habit of using, for a long time past, pure *creasote* as a remedy in erysipelas. He applies it lightly, once a day, to the affected surface with a camel-hair pencil, and has found it more effectual in arresting the disease than any other article he has ever tried. It destroys the cuticle, converting it into a whitish substance, which thus defends the inflamed surface from the contact of the air.

Solutions of acetate of *lead* and opium, Goulard's extract, alcohol, chloride of sodium, carbonate of potassa, sulphate of copper, and quinine, often prove beneficial in this disease. They are employed of varying strength, and are generally most grateful when used tepid, upon flannel cloths, frequently renewed. In warm weather, and in strong, plethoric subjects, they may be applied cold, but when this is done their effects should be sedulously watched, lest they repel the disease, or force it upon some internal organ.

Dr. Pitcher, of Detroit, strongly recommends, as an external application, the bichloride of *mercury*, in the proportion of twenty grains of the salt to the ounce of alcohol. During the prevalence of the epidemic already so frequently alluded to, I had occasion to try this treatment in quite a number of instances, and came to the conclusion that it possessed no advantage whatever over iodine and nitrate of silver. In nearly all the cases, upwards of twenty, the application was promptly followed by vesication and excessive pain, and, in a few, by pretty profuse ptyalism; effects which greatly aggravated the local and constitutional suffering, and rendered a speedy discontinuance of the remedy necessary. I have since tried the medicine in weaker solution, but without any encouraging results.

Velpeau has great confidence in the use of sulphate of *iron* as a local remedy in erysipelas. The praises, however, which he has lavished upon it have not been realized by practitioners generally, and the probability, therefore, is that they are undeserved. In the trials which I have made with it, I have been sadly disappointed. It may be employed in solution, in the proportion of half an ounce to two-thirds of a quart of water; or as an ointment, prepared by mixing one drachm of the impalpable powder with an ounce of lard. The former is applied by means of compresses, frequently moistened; while the latter is rubbed on freely several times in the twenty-four hours.

Professor Holston, of Washington City, has recently strongly recommended the local use of *chloroform* in the treatment of erysipelas, washed over the affected surface for a few minutes with a large camel-hair brush, the parts being immediately afterwards covered with wadding, and the application repeated, if necessary, at intervals of from three to four hours. Prompt relief, it is asserted, usually follows, the disease, even if extensive, often yielding in a very short time.

In the milder varieties of erysipelas I have occasionally witnessed excellent results from a *liniment* of equal parts of laudanum, ammonia, and olive oil, applied with a soft, thin compress. When the skin is very delicate, the proportion of ammonia may be diminished. The common soap liniment, with the addition of a small quantity of tincture of iodine, is also a valuable remedy in simple erysipelas.

Various *greasy substances*, cerates, and unguents have been recommended by practitioners, and employed by the vulgar, in the treatment of this affection; but there are few surgeons who place much reliance in any of them.

Perhaps the best is the mercurial ointment, first advised in this complaint by Dean and Little, of Pennsylvania. A thick layer of this is spread upon cloth, and secured to the part by means of a bandage; or, what is preferable, rubbed gently but efficiently upon the surface. The article has been highly lauded by Rayer and others, but my own experience has not supplied me with any facts in its favor. The opinion at the present time appears to be that the mercurial ointment of the shops does not possess any particular advantage over common lard, or simple cerate, and, from all that I can learn, the remedy would seem to have become nearly obsolete. I should certainly place no special confidence in it in the more severe forms of the malady, while in the more simple I should not deem it necessary to resort to it. In infantile erysipelas, I have sometimes derived good effects from the application of calamine cerate, diluted with two parts of lard. Professor Gibson has sometimes used, with marked benefit, the preparation known under the name of British oil; and Dr. Coates, of this city, has successfully employed tar ointment.

Dusting the affected surface with starch, flour, arrowroot, prepared chalk, carbonate of zinc, pearl powder, and similar substances, is a popular remedy, which is sometimes useful in the more simple varieties of erysipelas, but entirely unavailing when the disease is deep-seated, or of a phlegmonous character. In the former, they sometimes prove beneficial by relieving the disagreeable itching, smarting, or burning sensation of the skin. In superficial erysipelas, I have occasionally obtained advantage from painting the inflamed surface with collodion; the application appears to impart a healthful stimulus to the cutaneous capillaries, to incite the absorbents, and to contract the skin and subjacent cellular tissue.

The treatment of erysipelas by *blisters*, formerly so much in vogue in this country, has of late fallen into undeserved neglect. In my own practice I have frequently resorted to it, and in hardly any case has it disappointed my expectations. The remedy is peculiarly valuable in the phlegmonous form of sporadic erysipelas, and in erysipelas supervening upon wounds, ulcers, chancres, buboes, and abrasions. My practice is to apply the blister directly to the inflamed surface, with a small margin for the sound skin, and to retain it until it has produced thorough vesication. The serum is then discharged with a needle, and the part dressed with a light starch, elm, or some other emollient poultice. In children, and old or sickly persons, the blister must be removed at an earlier period, otherwise serious mischief may ensue from its overaction.

Much has been said, of late years, respecting the importance of *punctures* and *incisions* as means of relief in this complaint. Of the propriety of this mode of treatment, no one acquainted with its character can entertain the slightest doubt in any case, accompanied by suppuration, great tension, and impending gangrene. Under such circumstances, indeed, all other means must be regarded as of secondary moment; the knife alone is to be trusted, and the sooner it is resorted to the better. A few incisions, or a number of large punctures, will obviate an immense amount of mischief, by affording vent to effused fluids, as serum, lymph, pus, and even blood, relieving capillary strangulation, and removing pain and tension. The period for putting this practice in force is the moment there is the slightest perceptible fluctuation, and, in violent cases, even as soon as pain and throbbing show themselves. By thus anticipating the suppurative process, the patient escapes much suffering, as well as loss of texture; for, if the matter be retained in the parts, its inevitable tendency is to burrow among the surrounding structures, and, by being absorbed into the system, to contaminate the constitution. From neglect of this practice, many patients perish that might otherwise be saved, and many limbs are lost, or rendered useless for life.

In practising incisions for the relief of erysipelas, it is not necessary that they should be made three, four, or five inches in length, as recommended by Mr. Lawrence and other British surgeons. Such a procedure is eminently cruel and reprehensible, and it is difficult to conceive how it should ever have received the sanction of enlightened practitioners. Independently of the pain which attends it, it is liable to be followed by copious hemorrhage, which, occurring at a time when the patient is perhaps ill able to bear it, is well calculated, in many cases, to hurry him on to a fatal issue. I must, therefore, enter my solemn protest against such a barbarous practice. Incisions, I repeat it, are often eminently serviceable, if, indeed, not indispensable both to the part and system; but let them be made in a proper manner, and of proper dimensions. A cut from half an inch to an inch and a half in length, and deep enough to liberate the pent-up fluids, ought to be sufficient in any case, unless there has been great mismanagement on the part of the patient, or his professional attendant. In such an event, the incisions may be multiple, being placed at suitable intervals from each other. It is hardly necessary to add that, in performing the operation, the knife should not be carried in the direction of any important structures, as large vessels, nerves, or joints. If hemorrhage be unavoidable, it is to be arrested by the usual means, as compression, styptics, or ligation. The best application after the bleeding has ceased is an emollient poultice, or the warm water-dressing, either simple or medicated. The loss of a small quantity of blood is often of essential benefit in relieving the disease.

Punctures are more particularly useful in the œdematous forms of the disease, to evacuate the serous fluid upon which the distension depends, and which often forms a source of so much mischief. When suppuration or gangrene is threatening, punctures, as already stated, give way to incisions. The number of punctures, the depth to which they should be carried, and their proximity to each other, must depend upon circumstances. The best instrument for making them is a very narrow, sharp-pointed bistoury, introduced perpendicularly to the surface, with the necessary care to avoid important structures.

Finally, valuable aid may be derived, in almost every case of erysipelas of the extremities, from the application of the *bandage*. It is particularly efficacious in the early stages of the disease, being well calculated, if judiciously employed, to afford support to the affected structures, and to prevent vesication and suppuration. The application should be made as equably as possible, and with a certain degree of firmness, its effects being carefully watched, and aided by simple or medicated lotions.

SECT. II.—FURUNCLE, OR BOIL.

A furuncle, vulgarly called a boil, is a peculiar inflammation of the skin and cellular substance. Liable to occur upon any portion of the body, excepting, perhaps, the palm of the hand and sole of the foot, it is most common upon the face, nape of the neck, buttocks, and fingers, often forming in considerable numbers, either simultaneously or successively, although generally there is only one. Both sexes, and all periods of life are subject to it; the young, however, suffer more frequently than the old and middle-aged. Some persons are habitually affected with boils, being seldom entirely free from them at any time for years. Now and then they disappear for a while, and then suddenly break out again. Attacks of boils are a very common sequel of eruptive affections, as smallpox, measles, scarlatina, and typhoid fever. Children during dentition, and during chronic attacks of cholera, occasionally suffer enormously from this cause. I have often, in these complaints, seen the whole surface literally covered with boils, the patient experiencing great torment and bodily weakness.

The causes of furuncle are generally inappreciable. Occasionally we can trace their formation to external violence, as a contusion, or the concussion sustained by the skin and cellular substance in riding on horseback. In the majority of cases, if not in all, it is obviously connected with a disordered state of the digestive organs, or with some derangement of the secretions. Thus, persons who labor habitually under disease of the liver, and females who are troubled with irregularity or suppression of the menses, are very prone to suffer from its attacks.

A boil consists essentially in a circumscribed inflammation of the skin and subcutaneous cellular tissue, eventuating in suppuration and sloughing. It usually begins as a small, hard, red pimple, which, as it proceeds, gradually assumes a conical figure, the apex being formed by the skin, and the base by the cellular substance, its volume varying from that of a current to that of a pigeon's egg. The pain which accompanies it is, at first, of a burning, smarting character, but afterwards, especially when matter is about to be deposited, it becomes throbbing and exceedingly severe. A sense of tension is also commonly present. The skin is of a dusky, reddish aspect, and exquisitely sensitive to the slightest touch. As the tumor increases, a little vesicle forms at its apex, containing a drop of serum, and indicating the point where the boil will discharge itself. If the furuncle be large, or multiple, there will usually be more or less constitutional disturbance, as manifested by the want of appetite, a bad taste in the mouth, headache, chilliness, and a feeling of great uneasiness. Finally, if the disease occur in the lower extremity or upon the buttock, there will often be sympathetic enlargement of the glands of the groin, and in the upper extremity of the glands of the axilla. The period required for a boil to reach its height varies from three to eight days.

If a section be made of a boil, with a view to the examination of its structure, it will be observed to consist of a mass of dead cellular substance, ordinarily called a core, immersed in thick yellowish pus, the parts around being very hard, matted together with lymph, and preternaturally vascular. The skin is also indurated, and abnormally tense, red, and injected. Occasionally the contents of the swelling are almost wholly made up of blood, or of a mixture of blood, pus, and slough. This form of boil, to which the term hematoid may be applied, is most common in elderly persons of a broken constitution, and is generally attended with a great deal of local and general distress.

It is seldom, under any circumstances, that a furuncle can be made to abort, or to terminate in resolution, its invariable tendency being to suppurate and slough. In its very incipiency, I have occasionally, though very rarely succeeded in arresting its course by a brisk purge, and the application of iodine, but if it have already made some progress, such an attempt will prove altogether futile. The best plan generally is at once to poultice the part, and make an early and free incision to let out its contents. The relief experienced from the operation is always prompt and decided. If the sore is slow in healing, either from the retention of dead cellular tissue, or want of healthy action from other causes, its surface should be well touched with nitrate of silver; the same article, iodine, or a small blister being applied to the surrounding surface. In most cases the patient will be benefited by purgative medicine and light diet.

When there is a decided furuncular diathesis, as when a great number of boils exist simultaneously, or form in pretty rapid succession, benefit may be expected from an emetic, and from mercurial purgatives, with the internal use of iodide of potassium and Donovan's solution. Sometimes Fowler's solution of arsenic answers a good purpose, or, what I prefer, arsenic in substance, from the twentieth to the thirtieth of a grain three times a day. In very obstinate cases slight ptyalism may be required before the disease finally yields. When boils are developed as a consequence of exhausting diseases, tonics, mineral acids, a nutritious diet, and country air are indicated. Alkalies should be used when there is evidence of acidity of the stomach and bowels. Daily bathing with salt water, or water impregnated with potassa, will occasionally be serviceable, especially when there is unusual torpor of the skin.

SECT. III.—ANTHRAX, OR CARBUNCLE.

The most accurate definition that can be given of a carbuncle is that it is a boil on a large scale, it being, like that affection, a peculiar inflammation of the cutaneous and cellular tissues, but, instead of being circumscribed, as in that disorder, it manifests a disposition to spread. Its most common seat is the posterior part of the trunk, particularly the nape of the neck, near its junction with the occiput. The gluteal and sacral regions are also liable to the disease, but it is very seldom that it occurs in the extremities. A bad form of carbuncle occasionally exists upon the chin and lower lip.

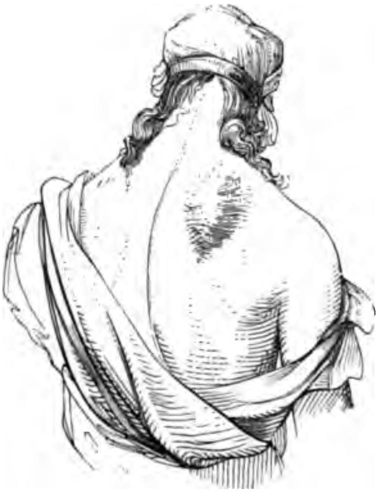
Elderly persons are most prone to carbuncle, and it is generally believed that such as are fat and indolent, or addicted to the pleasures of the table, are more frequently attacked than the lean and active. In my own practice, however, this has not been the case. On the contrary, the greatest number of instances has occurred in thin subjects, after the age of fifty, whose constitution had been broken down by long-continued intemperance, impoverished diet, deficient clothing, and mental anxiety. In London carbuncle is said to be remarkably common among the lower orders, in consequence of the enormous quantities of ale and porter which they habitually consume. The disease is more frequent in winter than in summer, and in men than in women; occasionally it displays an epidemic tendency. Carbuncle is one of the symptoms of plague. The extent of the inflammation varies from that of a dollar up to that of a large saucer, its average being about that of the palm of a small adult hand.

Of the exciting *causes* of carbuncle nothing whatever is known. Most commonly the outbreak of the disease is ascribed to the effects of cold, to disorder of the stomach, over-eating, constipation of the bowels, loss of sleep, excessive venery, and other debilitating influences; but how far, or in what degree, these circumstances tend to favor its development it is impossible to say. I have myself long regarded the malady as essentially of a constitutional nature, resembling, in this respect, erysipelas and some other affections; and a careful study of the history of the disease certainly warrants such an inference. A long course of debauch, or indulgence in the pleasures of the table, attended with a vitiated state of the secretions, is, as is well known, eminently conducive to the development of carbuncle in its worst forms. When a person has been for years in this condition, eating and drinking luxuriously, and taking hardly any exercise, the slightest exposure to cold, suddenly checking the cutaneous perspiration, would, it may easily be imagined, tend to produce the disease in a part habitually congested and enfeebled in its action. But there is then not merely a bad state of the solids; the blood also comes in for a share in the proceeding, surcharged, as it must be, with irritating materials which the solids have long been unable to throw off as recrementitious substance. Whether, however, this conjecture be correct or not, the fact is indisputable that carbuncle is rarely, if ever, of traumatic origin, or found in persons of a vigorous and healthy circulation.

The first *symptom* of carbuncle is generally an itching, burning, or smarting, with a sense of numbness, in a particular part of the skin, which, on examination, is found to be of a dusky, reddish color, slightly tumid, and somewhat tender on pressure. As the disease progresses, the local distress sensibly increases; the pain soon becomes throbbing and exceedingly violent, the part feeling as if it were in contact with melted lead; the surface assumes a livid hue; the swelling spreads both in circumference and in depth; and the slightest touch of the finger is intolerable. Along with these phenomena, the patient usually experiences a sense of weight and tension, which greatly adds to his suffering. The part is hard, and circumscribed, feeling like the rind of bacon, and occupying a space from the size of a dollar to that of the palm of the hand. Presently vesicles begin to form at the focus of the inflammation, containing a dirty turbid, yellowish, or sanguinolent fluid, and generally not exceeding the diameter of a pea, though occasionally they are quite large. Upon bursting, these vesicles expose a corresponding number of openings in the true skin, giving the surface a cribriform appearance, and leading down into the cellular substance, which is already in a state of mortification. The ulcers, for so they may be called, have an irregular, ragged appearance, and are the seat of a foul, irritating discharge, which is often very abundant and exhausting.

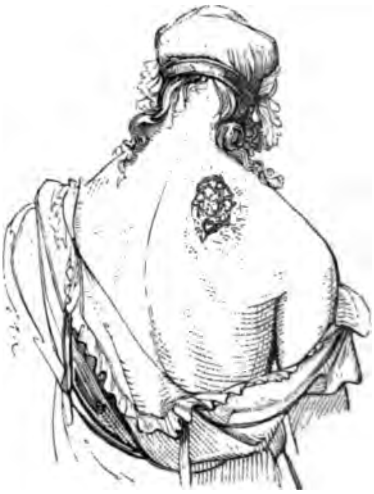
Upon dividing the affected structures, the skin is found to be remarkably dense and firm, cutting very much like the rind of bacon. The cellular substance beneath is converted into a slough, having the appearance of a mass of wet tow, being bathed with ill-looking matter, and intermixed with flakes of lymph, or matter like putty, thick pus, or curds. When the disease is of unusual extent, there may be considerable involvement of the aponeuroses and muscles, but in general these structures are excluded from the morbid action, the skin and subjacent cellular tissue alone suffering. At the periphery of the disease the parts are always uncommonly dense, the boundary between it and the healthy structures being established by a deposit of plastic matter, less organizable, however, than in furuncle, the morbid anatomy of which that of a carbuncle so closely resembles. The subjoined sketches, figs. 184 and 185, represent this disease in its earlier and more advanced stages.

Fig. 184.



Carbuncle in its forming stage.

Fig. 185.



Ulcerated carbuncle.

The *constitution* always, at an early period of the disease, strongly sympathizes with the part affected. Hence, fever is generally present soon after its commencement, and sometimes, indeed, almost before there is any marked evidence of the local affection, the first symptom being often a severe rigor, followed by high vascular excitement. However this may be, the case soon assumes an asthenic type, indicative of the depraved condition of the solids and fluids so intimately concerned in the production of the disease. The tongue speedily becomes dry, hard, and brown, sordes collect upon the gums and teeth, the appetite fails, gastric derangement exists, the bowels are constipated, the urine is scanty and high-colored, the skin is hot and arid, the mind is disposed to wander, and the pulse is frequent, soft, and without force. Vomiting is often present to a considerable extent, and the alvine evacuations are generally excessively fetid.

There is no disease with which carbuncle can be *confounded.* Its large size, the severity of the attendant pain, and the great constitutional disturbance will always readily distinguish it from furuncle at its commencement, and afterwards the diagnosis will be still further aided by the vesicated and cribriform condition of the skin, so characteristic of carbuncle. The only affection which it at all resembles is a bedsore, but the history of the case, and the situation of the swelling, will always serve as means of discrimination. Malignant pustule begins as a little circumscribed pimple, not as a diffused swelling, as in anthrax, and soon forms a large vesicle, raised above the surrounding level, and resting upon a hard, solid base, which rarely acquires much extent, at least not until the affection has made considerable progress.

A carbuncle is generally a *dangerous* disease, especially so when it is multiple, or when it occurs in old, fat subjects, addicted to indolence and overfeeding. The site of the disease will also exert a marked influence upon the issue of the case. Thus, a carbuncle situated on the back part of the head and neck will, other things being equal, be more likely to produce death than when it occupies the back, nates, or extremity, inasmuch as it is extremely apt to involve the brain and arachnoid membrane, causing effusion of serum and lymph. Young and comparatively healthy persons will often recover, though generally not without great suffering, whatever may be the site of the malady.

Treatment.—The treatment of carbuncle must be conducted with special reference to the improvement of the secretions and the support of the system. Few patients will be found to bear bleeding, or anything like active purgation. It is only when there is extraordinary plethora, combined with great vigor of constitution, that these means should be carried into effect. In all other cases, their inevitable tendency will be to do harm, by bringing on premature exhaustion. Efficient purging, however, may be regarded as an indispensable remedy in almost every instance, the object being not only to get rid of irritating fecal matter, but to produce a change in the secretions. For this purpose the medicine should be given early in the disease, and a mercurial cathartic should always be preferred to any other. When marked gastric derangement exists, as indicated by nausea, headache, and pain in the limbs, no time should be lost in administering an efficient emetic, or an emetocathartic, as ten grains of calomel and from ten to twenty of ipecacuanha, followed by large draughts of chamomile tea, or infusion of valerian. Clearance having been effected, and function improved or restored, stimulants and tonics will come into play, exhibited warily, especially if cerebral trouble is threatened, yet efficiently if evidence of exhaustion is present, the most suitable articles being ammonia, quinine, chloride of iron, and brandy, with nourishing broths. Anodynes will generally be required, in large doses, to allay pain and procure sleep. After the first few days a mild laxative, as blue mass or castor oil, is occasionally given. Determination to the brain must be promptly met by a large blister applied as near as possible to the occiput.

The best *topical application*, in the early stage of carbuncle, is the warm water-dressing, medicated with acetate of lead and opium. Pencilling the surface well with tincture of iodine, and then covering it with a mixture of equal parts of olive oil, laudanum, and spirits of turpentine, sometimes produces a very soothing effect. In many cases, there is nothing so promptly beneficial as a blister, large enough to include a considerable portion of the healthy skin, and retained until it has caused thorough vesication; it drains the vessels of serum, allays pain, and makes a salutary impression upon the general system. Leeches are commonly inadmissible, as they cause severe pain, and undue depletion. But the great remedy for carbuncle, as for furuncle, is free incision, the knife being carried into the healthy substance beneath, not at one point, but at a number. The operation, which should be practised as soon as possible at the focus of the disease, and afterwards towards the periphery, should there be any necessity for it, at once relieves the horrible pain and tension of the part, affords nature an opportunity of casting off the sloughs, and puts an effectual barrier to the further extension of the morbid action. I cannot see any reason why practitioners should still continue to apply caustics in these cases when the knife is so much more prompt and effectual in its action. If the dead tissues are slow in coming away, their extrusion may be expedited with the scissors, the surface of the ulcer being well touched immediately afterwards with the dilute acid nitrate of mercury, or nitrate of silver, to promote the formation of healthy granulations. As soon as this has been brought about, the part is dressed with some mild unguent, as the opiate cerate, elemi ointment, or ointment of the balsam of Peru.

After recovery, the tendency to a recurrence of carbuncle, which is sometimes very strong, should be counteracted by a change of air, attention to diet, a proper regulation of the secretions, and the avoidance of exposure to cold and fatigue, aided by an alterative course of iodide of potassium, the dose of which should not exceed two grains and a half thrice in the twenty-four hours. If there has been much disorder of the secretions, a very minute quantity of bichloride of mercury may be advantageously conjoined with the potassium. When there is marked derangement of the digestive functions, attended with acidity and flatulence, recourse may be had to the chlorate of potassa, given three times a day, in doses of from five to ten grains, until there is manifest improvement in the tone of the stomach and of the general health. A change of air is often indispensable to complete convalescence.

SECT. IV.—GANGRENE AND BEDSORES.

The skin is liable to gangrene, both idiopathic and traumatic, simple and specific, acute, and chronic; but as these several varieties have already received a sufficient share of attention, nothing need be said respecting them here. There is one species, however, which may be briefly described in this place, inasmuch as no special mention has been made of it elsewhere. I allude to what is called *white* gangrene of the skin; an affection whose true character is still involved in obscurity, nothing that has yet transpired having thrown any light either upon its pathology or treatment.

White gangrene usually comes on without any appreciable cause, or premonitory symptoms, in patches of irregular shape, from one to three inches in diameter. The sloughs are of a dead, milky color, and of a hard, dryish consistence, yielding little, if any, moisture on pressure. Any portion of the body may be the seat of this affection; but observation has shown that the arms, back, and chest are the regions most frequently implicated. The disease has hitherto been observed chiefly in old persons of a broken, anemic constitution. The treatment is to be conducted upon general principles, special reference being had to the improvement of the health by tonics, brandy, and nutritious diet.

Bedsores.—There is another variety of gangrene of the integuments which, from the frequency of its occurrence, and the severity of the attendant suffering, merits special attention here. The immediate cause under whose influence it is developed is steady and protracted pressure, impeding, and generally arresting, the circulation; hence it is exceedingly liable to arise on the sacro-lumbar region, the iliac projections, on the nates, and over the great trochanter, in consequence of long-continued confinement to one particular posture, as happens in typhoid fever, in severe fractures and wounds, and after surgical operations. Persons who have received violent injuries upon the back, eventuating in paralysis of the lower extremities, are more than commonly prone to this variety of gangrene, or bedsore, as it is usually called. I have at this moment under my charge a tall young man, affected for the last six months with paraplegia, who has a large and excessively painful ulcer upon the left buttock, merely from the pressure sustained in sitting on a chair.

The disease is always necessarily preceded by inflammation, but in consequence of the absence of the usual symptoms, the want of proper care in examining these parts and keeping them clean, or the impossibility which the patient experiences in communicating a knowledge of his suffering, as when he is exhausted by typhoid fever, or other causes, it does not always attract attention until great mischief has been done, eventuating in extensive sloughing, and the establishment of painful, irritable ulcers, which it is often extremely difficult to heal. In some instances the first intimation which the patient has of the approaching mortification is a sense of prickling in the affected parts, as if he were lying upon some rough substance, as sawdust, or coarse salt. At other times, he feels severe pain, of a stinging, burning, or biting character, within a few days after he has been exposed to the pressure, and which is often so constant and distressing as to deprive him both of appetite and sleep. Upon examining the parts to which the suffering is referred, the surgeon finds that they are red, or marked by an erythematous patch, slightly swollen, with a dense base, congested, and excessively tender on pressure. Ulceration, if it have not already taken place, will be sure to begin in a short time, unless suitable measures are adopted for the patient's relief, and will be speedily followed by mortification, or mortification may take place without being preceded by ulceration.

The extent to which the gangrene may proceed is variable; we occasionally see it occupying an immense surface, perhaps as large as the crown of a hat, and reaching down to the very bones; at other times it is more limited both in diameter and depth, laying bare merely the muscles, or being even in great degree confined to the skin. In rare cases, the ravages are not limited to the soft structures, but involve also the osseous tissue.

Bedsores, unless of very trivial extent, are among the most formidable complications liable to arise during the progress of fevers and other diseases, as well as after accidents and operations. As they seldom occur until the vital powers have been materially depressed, the excessive pain and drainage occasioned by them are often so severe as to destroy the patient, or, at all events, greatly retard his convalescence.

The *treatment* of bedsores, or gangrene from pressure, is prophylactic and curative. In the first place, whenever there is any probability from the nature of the case that the confinement is destined to be a tedious one, and attended with constant decubitus, or a helpless state of the patient, means should be promptly adopted for hardening those parts of the surface which long experience has taught us as being most likely to suffer under such circumstances. For this purpose they should be brushed once or twice a day with tincture of iodine, at first diluted, and then pure, or washed repeatedly with a saturated solution of alum and tannin. The greatest possible attention should be paid to cleanliness, and to the arrangement of the sheets and clothes, that they may not be rolled up under the body, and thus become a source of suffering and disease, as too often happens in the hands of careless and thoughtless practitioners. As to the use of plasters, I have very little patience with them, for, unless they adhere well, they are extremely apt to become rumpled, much to the detriment both of the part and system. Change of posture should receive early attention, though this is not always practicable, from the inability of the patient to maintain himself in any other situation than that on the back. When the patient can afford it, he should use an air bed.

The moment any decided suffering is experienced, or the parts become red and inflamed, a ring-shaped air-cushion should be provided for the purpose of equalizing the pressure, or, in the absence of this, an ordinary cushion, with a suitable central hole, the edges being broad and well padded with wool or horse hair. Such a contrivance, however, is a very imperfect substitute for the air or water cushion, which should therefore always have the preference.

When gangrene is threatened, the best application is the tincture of iodine, aided, if there be much pain and tension, by one or two moderately free incisions, and followed by a yeast or port-wine poultice, sprinkled with laudanum, morphia, or powdered opium. Cleanliness is promoted by the liberal use of the chlorides and by the early removal of the sloughs. When granulations begin to spring up, the best dressing will be opiate cerate, balsam of Peru ointment, or a mixture of equal parts of castor oil and balsam of copaiba.

The constitutional treatment of bedsores must be conducted according to the general rules followed in typhoid states of the system from whatever cause proceeding. Nutritious food, wine, brandy, milk punch, quinine, and anodynes are the means chiefly to be relied upon for upholding the flagging powers of nature. This treatment can hardly be commenced too soon whenever there is any tendency to the formation of bedsores, for the very fact that such a tendency exists is a sufficient reason for redoubling our efforts to support the patient's system.

SECT. V.—BURNS AND SCALDS.

There are few accidents which are of more common occurrence than burns and scalds, or which entail a greater amount of suffering and deformity. The progress of civilization, and the improvements in the arts and sciences, have greatly multiplied their frequency and severity, and call for corresponding attention on the part of the surgeon. From what I have seen of these lesions, I am satisfied that few practitioners understand their character, or treat them with the success of which they are capable. One reason, perhaps, of this is that every one has a remedy for them, and that hardly any two agree as to the kind of treatment best adapted to their relief.

Burns and scalds differ from each other simply in this, that the one is the result of dry heat, and the other of moist. They both present themselves in various degrees, from the slightest erythematous blush of the skin to the total destruction of all the structures of a limb. Their extent also is exceedingly variable, both as it regards their depth and their superficial area. Thus, while in one case they may involve only a little patch of skin hardly the size of half a dime, in another they may occupy an immense extent of surface; or, instead of being diffused over a large space, the injury may be concentrated upon a small spot, but penetrate to a considerable depth. These differences are of great practical importance, on account of the influence which they exert upon the issue of the case. The division of Dupuytren of burns and scalds, so generally adopted at the present day, seems to me to be most complex and unscientific, and therefore well calculated to embarrass the progress of the inquirer. No one can doubt that the more simple the arrangement of a subject is, the more easily, in general, it is understood. In accordance with this idea, I shall describe burns and scalds as consisting of two classes, the simple and complicated; comprehending under the former term those lesions which, however extensive, produce only inflammation, and under the latter those which cause the death of the parts, either on the instant, or within a short time after their infliction.

Burns are most common in winter, among the poorer classes, who are very liable to have their clothes set on fire in consequence of the manner in which they crowd around the hearth and grate to keep themselves warm. Women, on account of the peculiarity of their occupation, are more subject to them than men, and children than grown persons. Blacksmiths, plumbers, glass-blowers, and foundry men are particularly exposed in this way. The introduction of gas and camphene has been a fruitful source of these accidents. Scalds, on the other hand, are most common in kitchens, breweries, in different kinds of factories, especially soap and candle, and in all places where steam is employed, whether for domestic or public purposes. On our western waters, where steamboat explosions are of frequent occurrence, many persons are annually destroyed by the effects of hot water. Those parts of the body which are habitually exposed, as the hands and face, are most liable to suffer both from burns and scalds, especially the latter, steam often penetrating the clothes in every direction. Dry and moist flame, hot water, and steam often enter the mouth and throat, producing violent, if not fatal, effects. A heated iron has been known to be thrust up the rectum for the purpose of homicide, as in the famous case of Edward II.

It is well known that different agents possess different degrees of capacity for caloric, and that, consequently, they are capable of producing different effects when brought in contact with the living tissues. Thus, experience has shown that boiling metal will cause a more severe impression than boiling oil, and boiling oil than boiling water. The intensity of the injury, however, is not always in proportion to the relative capacity of the substance for heat; for it is well ascertained that copper will, other things being equal, occasion a more violent effect than iron, although the latter possesses a greater capacity for caloric. This fact can be explained only on the assumption that some articles are not only better conductors of heat than others, but that they adhere more firmly to the surface, thus favoring its protracted extrication. Alcohol and ether, from their great volatility, usually produce only superficial burns.

In the milder forms of these accidents there is merely an erythematous appearance of the skin, such as may readily be produced by exposing the back of the hand for a few moments to a stove, or by applying hot water to it. The discoloration is usually very temporary, but at times it is more permanent, lasting for a number of hours, and being perhaps soon followed by slight vesication. The pain is of a smarting, pungent character, but comparatively trifling, and soon goes off. The constitution remains unaffected.

The application of heat, whether dry or moist, unless sufficient instantly to destroy the vitality of the part, or so slight as to make only the most superficial and transient impression, is always speedily followed by an evolution of vesicles, containing a thin, watery fluid, identical with the serum of the blood, from which it is derived. When the vesicles are more slow in forming, as when they are the product of the resulting inflammation rather than of the immediate effect of the caloric, their contents are, in general, partly fluid and partly solid, the latter consisting either of lymph or of fibro-albuminous matter. Their volume varies from that of a pin-head up to that of a fist, their number being usually in an inverse ratio to their dimensions. Cases are occasionally met with where the epidermis nearly of a whole limb, or the greater portion of the trunk, is elevated into one enormous blister, establishing a most frightful drainage upon the blood.

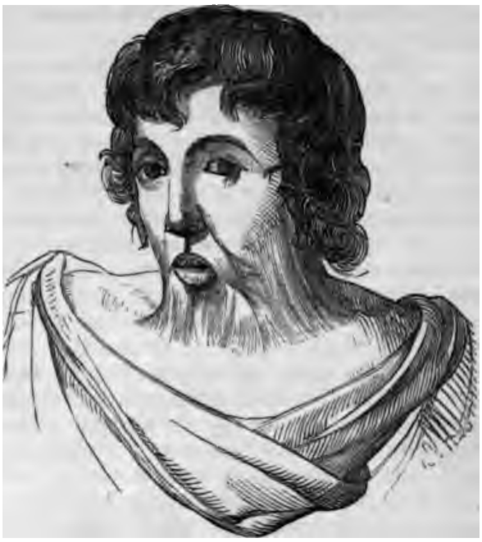
The surface around the vesicles is of a scarlet color, more or less tumefied, and exquisitely tender on pressure, or on exposure to the atmosphere. The pain is of a burning, scalding character, and so severe as to cause the most intense agony. The part rapidly swells, feeling stiff and tense, and the pain assumes a throbbing character. Well-marked constitutional symptoms are always present, especially if the lesion is at all extensive, and the patient may be delirious, excessively restless, and intensely thirsty.

These injuries are said to be *complicated* when they are attended with the destruction of the vitality of the part, or some other serious lesion, as a wound, fracture, or dislocation. The loss of life may be limited to the skin and subjacent cellular tissue, or it may extend much deeper, involving muscle, aponeurosis, vessel, nerve, and bone all in one common eschar. Such accidents are never produced in any other way than by burns, as when a person falls into the fire, or gets his limb in a stove, grate, or furnace. Dreadful scalds, however, sometimes occur from the protracted application of boiling fluids, as happens now and then in breweries and soap factories. Under such circumstances, the loss of vitality, although not as extensive as we sometimes find it from the operation of dry caloric, is yet sufficient to be productive of the most terrible ravages. The epidermis comes off in large sheets, no vesicles exist, or only around the border of the injured surface, and the skin is of a dirty grayish, cineritious, or yellowish color, sodden, insensible, and marked, here and there, by a purplish line, indicating the course of a subcutaneous vein.

Besides the pain which invariably attends all burns and scalds, no matter how slight, or wheresoever situated, there is apt to be more or less *constitutional* disturbance, coming on at a variable period after the accident; sometimes immediately, and at other times not for several hours, days, or weeks. When the injury is at all extensive, the patient will have all the symptoms of one laboring under a severe shock. He will feel exceedingly cold, or, perhaps, have violent rigors; the pulse will be small, frequent, and feeble; the respiration will be oppressed; and there will be extreme restlessness, along with great thirst and sickness at the stomach. The patient, in fact, lies in great torture, pale, prostrated, agonized. Reaction taking place, he will have violent fever, a flushed countenance, and a quick, frequent pulse, with a tendency to delirium; pain, of a pungent, burning character, forming all the while a prominent symptom. If the excitement run high, there will be danger of over-action in the part, and of inflammation of some of the internal viscera, of the arachnoid membrane, and of the mucous lining of the bowel. Numerous cases have been published within the last fifteen years going to show that ulceration of the duodenum is one of the most frequent lesions which supervene upon scalds and burns of the cutaneous surface; and, in the more chronic forms of these accidents, the same disease is sometimes widely diffused over the colon, thus accounting for the profuse and obstinate diarrhœa which is so often present under these circumstances.

Among the more common local *consequences* of burns and scalds are, the formation of vicious scars, the adhesion of contiguous surfaces to each other, the retraction of the affected parts, anchylosis of the joints, and various transformations of the cicatricial structures, especially the keloid. The scars, which are often of frightful extent, and horribly disfiguring, possess an extraordinary contractile power, which does not cease for a long time, which it is almost impossible to counteract, and which frequently draws out of place every tissue that is brought under its influence, bone not excepted. Owing to this circumstance, the chin is occasionally drawn down against the sternum, as seen in fig. 186, and the lower maxilla singularly changed in shape. The fingers may be retracted like claws, or literally buried in the palm, the hand thrown back at a right angle with the wrist, or the forearm drawn up against the arm, which is itself, perhaps, firmly pinioned to the side. Similar effects occur in the inferior extremity. Thus, the foot is sometimes tied to the forepart of the leg, and the leg to the posterior surface of the thigh. In neglected burns of the hand, the fingers are often united to each other, so as to give them a webbed appearance.

Fig. 186.



Vicious cicatrices of the face and neck, caused by a burn.

Burns and scalds are among the most *dangerous* of accidents. If at all extensive, they often terminate fatally from mere shock of the system, without, perhaps, even the slightest attempt at reaction; or, if reaction should occur, life may afterwards be assailed by inflammation of some internal organ; or death may take place at a more remote period, in consequence of the secondary effects of the lesion. A superficial injury of this kind is generally dangerous in proportion to its extent. Thus, a scald involving an entire limb or the greater portion of the trunk, although merely affecting the external layer of the true skin, is always a most serious accident, liable to be followed by the worst results. On the other hand, the danger is hardly less when the lesion is very deep, although it may not be more than a few inches in diameter. When depth and great extent of surface are combined, the chances are that death will occur without reaction, or, at all events, soon after reaction has taken place, from constitutional irritation. A prognosis, therefore, should not be given without due regard to these circumstances.

These injuries, moreover, are more dangerous in infants and children than in adults, on account of the greater susceptibility of their nervous system. Old persons, too, are very intolerant of them, and are liable to suffer severely, both primarily and secondarily. Pregnant females occasionally abort from their effects; and in the intemperate they often lead to the development of delirium tremens and other distressing symptoms. A burn on the neck and scalp is liable to cause arachnitis; of the chest, inflammation of the lung and pleura; of the abdomen, peritonitis and enteritis. Finally, a patient, after having manfully struggled against ebb and tide, as it were, for weeks and months, may finally be worn out by profuse discharge and hectic irritation.

Treatment.—The indications in the treatment of these lesions are, first, to produce reaction and calm the system; secondly, to limit the resulting inflammation; thirdly, to promote the sloughing process, when death has taken place, and to favor the development of granulations; fourthly, to moderate contraction, and prevent anchylosis; and, lastly, to sustain the strength during the wasting effects consequent upon the protracted suffering which so often occurs when the patient has escaped from the primary effects of these injuries.

To raise the system from the *depression* or collapse into which it so frequently sinks, even in comparatively slight burns and scalds, immediate recourse should be had to the exhibition of a full anodyne, along with hot toddy, ammonia, sinapisms to the extremities, and artificial warmth. The quantity of morphia, or whatever form of opium may be used, should be at least double what it is in ordinary accidents, the system being always, under these circumstances, uncommonly tolerant of the medicine. A large dose will not only be conducive to speedy reaction, but will greatly assist in allaying pain and calming the system. If the shock has been unusually severe, it may be necessary, in addition to these means, to use stimulating injections and to rub the spine with some irritating lotion. In the child and old man, care is taken not to urge on the reaction too rapidly, or to give opium without a certain degree of caution, lest the subsequent excitement should overtax the enfeebled brain and heart, thereby leading to visceral effusion. As the circulation comes up, the stronger stimulants are gradually withdrawn, the more simple alone being now trusted to for relief.

The second indication is to moderate the resulting *inflammation.* With this view various remedies may be employed; but what these remedies ought to be is a point respecting which there is still much contrariety of sentiment; nor is it at all probable that the question will soon be settled one way or another. In the milder forms of these accidents the practitioner can hardly go amiss if he employs almost any of the numerous articles that have been recommended by the profession and the people. He will find that, at one time, the part and system are most comforted by cold applications, and, at another, by warm; that to-day the one is borne best, and the other to-morrow; that one patient is benefited by an ointment, and another by a lotion; that in one case he may use moist applications with most advantage, and in another dry; in short, that the utmost diversity obtains in regard to the tolerance of this remedy or that. I am sure that the force of these remarks must often have been felt by every one at all extensively engaged in the practice of surgery. It is not surprising, therefore, as was stated at the opening of this section, that there should still be such a diversity of sentiment in relation to the proper management of these accidents.

Cold applications are chiefly adapted to very young, robust subjects, during the heat of summer, but even then they should not be resorted to without great care, for fear of internal congestion and effusion. The proper plan is to use them only so long as they are grateful and soothing to the system, and to discontinue them the moment they are found to be disagreeable. They may consist simply of cold water, spirits and water, or weak solutions of acetate of lead; and the same articles may be applied warm, care being taken, when the one class follows the other, that the transition is gradual and gentle, not sudden and violent. If the lesion be very slight, the surface may be covered with poultices of scraped potato, apple, turnip, starch, arrowroot, or slippery elm; carded cotton; saturnine unguents; or cloths wet with soap liniment, or a liniment made of lime-water and linseed oil. The latter constitutes the famous application so much used at the Carron Iron Works in Scotland; it is, however, exceedingly filthy and disgusting, and should therefore be discarded from genteel practice. Carded cotton, an American remedy, has always stood high in the estimation of the public, and there are few articles that are more constantly or more advantageously employed in the treatment of burns and scalds. A remedy from which I have often derived signal benefit in the milder varieties of these affections is the dilute tincture of iodine, in the proportion of one part to two of alcohol. It is only applicable, however, when the skin is unbroken.

In my own practice, I have experienced the most signal benefit in the treatment of burns and scalds from *carbonate of lead*, in the form of white paint; and in 1845 I called the attention of the profession to the subject in a short article inserted in Dr. Bell's Bulletin of Medical Science. Numerous observations made since that time have only served to confirm the views then expressed. From its great efficacy, and the readiness with which it can usually be employed, this mode of treatment deserves to come into more general use. It is not applicable merely to the milder forms of burns and scalds, but it may often be advantageously used, no matter what may be the extent or depth of the injury.

As the lead of the shops is very stiff, and, consequently, unfit for use, my invariable plan is to incorporate with it a sufficient quantity of linseed oil to make it of the consistence of thick cream. Thus prepared, the affected surface is thickly and thoroughly coated with it by means of a large camel-hair pencil, a soft mop, or a small paint-brush. If vesicles exist, their contents are evacuated with a fine needle, and the parts are well dried; otherwise, the lead will not adhere. The dressing is completed by covering the painted surface with a layer of carded cotton, or a piece of old muslin or linen, supported by a moderately firm roller. In mild cases, one application of this kind, allowed to remain on four or five days, will usually suffice to effect a cure. In the more severe forms of the lesion, on the contrary, a considerable number may be required. Whenever the dressings become stiff or saturated with secretions, they should be removed, others being immediately substituted.

I have never witnessed any bad effects from white lead paint, applied as here stated, although I have used it very freely in quite a number of cases. In one instance, that of a negro girl, sixteen years of age, who had a most severe and extensive burn of the neck, chest, and abdomen, I maintained the application upwards of five weeks, consuming more than a quart of the lead, without observing the slightest injury. In short, my experience induces me to believe that the treatment is perfectly safe in all cases, whatever may be the extent or depth of the lesion, or the age of the patient. Where a counter-poison. however, is deemed necessary, it will be readily found in the occasional exhibition of a dose of sulphate of magnesia, which, while it keeps the bowels in a soluble state, combines with the lead, forming an inert sulphate.

White lead paint probably produces its good effects in two ways: first, by forming a varnish to the affected surface; and, secondly, by directly obtunding its nervous sensibility. In many cases, it acts literally like a charm; the patient, in a few moments, becoming perfectly calm, and passing, as it were, from torment into Elysium.

Professor T. G. Richardson, of New Orleans, has recently employed with excellent effect the *subnitrate of bismuth* in the treatment of burns and scalds, his experience inducing him to give it a decided preference over white lead. His mode of using it is to rub the bismuth in a mortar with a sufficiency of glycerin to convert it into a thick paint, which is then freely spread upon the affected surface with a suitable brush, the parts being afterwards covered with carded cotton, retained by a roller. In the milder forms of the accident a single application often effects a cure.

In Boston, a plan of treating burns and scalds is used with much advantage, consisting of the application of a thick coating of mucilage of gum Arabic, which is immediately after well dusted with dry powder, the whole forming a complete defence to the raw surface beneath. Mr. Meadows, of London, has recently recommended, for a similar purpose, a mixture of collodion and castor oil, in the proportion of two parts of the former to one of the latter. The preparation, which may be kept ready for use for any length of time in an air-tight bottle, is applied by means of a camel-hair brush, and is speedily converted into a firm, adherent covering, the thickness of which may afterwards be increased if deemed proper. In the more simple forms of scalds and burns, the application of glycerin is occasionally very beneficial.

Where a stimulant effect is required, as when the parts are in a condition verging upon gangrene, the most eligible dressing, perhaps, is Kentish's ointment, composed of one ounce of basilicon ointment and one drachm of spirits of turpentine, and spread upon strips of old muslin, bound on lightly by a roller; or, instead of this, the surface may be carefully pencilled with a weak solution of nitrate of silver, nitric acid, or acid nitrate of mercury, and then covered with a yeast, port wine, or tannin poultice.

Along with these means, proper attention is paid to the state of the constitution, the bowels are maintained in a soluble state, diaphoretics are given to restore the functions of the skin, and the diet is carefully adapted to the emergencies of the particular case. The internal organs, particularly the brain and lungs, are sedulously watched, the avenues to disease being guarded by leeches and other suitable remedies for preventing inflammation.

If, despite the utmost care and attention, the injury terminates in *mortification*, or if the vitality of the parts was destroyed in the first instance, an effort should be made to check its further progress, and to promote the separation of the sloughs. The most suitable remedies for this object are such as are in use for ordinary gangrene. Fetor is corrected with the chlorides. If the sloughs are very firm, the knife may be used, but not without the greatest caution, lest pain and hemorrhage be induced.

As soon as the sloughs have dropped off, the indication is to promote the development of granulations; a circumstance which often requires much judgment and practical skill. The best remedies are the warm water-dressing, with the use of a very weak solution—not more than two drops to the ounce of water—of nitric acid. Sometimes the calamine cerate is very soothing, and seems to do good when almost everything else fails. If the granulations manifest a tendency to become exuberant, as they are very apt to do, they must be repressed with the scissors, nitrate of silver, and systematic compression, tonics being given to support the system. Cases occur in which these bodies are rendered exquisitely sensitive, the slightest touch being followed by the most lively pain. We usually find that this condition is attended with an irritable state of the constitution, and that, consequently, it requires something more than mere topical medication to get rid of it. A judicious course of anodynes and tonics, with the occasional application of nitrate of silver, and the constant use of an elm poultice, constitutes the proper treatment. Occasionally, no local remedy is so soothing as white lead paint. Whatever means may be employed, it will be found that they will require to be frequently varied; as one loses its effects another taking its place.

To obviate *deformity* constitutes the fourth indication in the treatment of these injuries. The points to be attended to are threefold: first, to prevent adhesions between contiguous surfaces; secondly, to counteract the tendency to vicious contraction; and, thirdly, to obviate anchylosis.

Allusion has already been made to the tendency which contiguous surfaces have to unite to each other during the progress of these accidents. This tendency is not confined to the fingers and toes, but is exhibited also in other parts of the body, as between the arm and trunk, the two labia, the thigh and scrotum, the ear and scalp. Whenever it appears, it must be carefully counteracted by the use of the bandage and the interposition of lint, aided, if need be, by splints. It does no credit to a surgeon to send forth his patient, after the completion of cicatrization, with webbed hands and feet, or with his arms pinioned to the side of the chest, although such occurrences are not always entirely avoidable.

The disposition to contraction in burns and scalds attended with loss of substance is always great, and is often productive of the most frightful deformity. To counteract this disposition, recourse should be had, early in the treatment, to carved splints and tin cases, judiciously applied, and steadily used, not only until the parts are well, but for a long time afterwards; experience having shown that the tendency to contraction continues for months, if not years, after the completion of the cicatrization.

If, from neglect, mismanagement, or unavoidable circumstances, the contraction has seriously impaired the usefulness of the part, or greatly marred the person's beauty, relief should be attempted by the division of the offending cicatrice, or, perhaps, by its excision, the raw edges being afterwards united by suture, or adapted to a flap of integument from the neighborhood.

This operation, constituting what is termed *dermoplasty*, should not, however, be undertaken without due preparation of the system, for it will readily be observed that when the cicatrice is very large, two most extensive wounds will be made, thus inflicting a violent shock upon the constitution, extremely liable to be followed by erysipelas and a low form of fever, under which the patient might easily sink. At least a fortnight should be spent in this kind of preliminary treatment.

The operation should be performed while the patient is under the influence of chloroform, and great care should be taken to dissect out every particle of the inodular tissue. To accomplish this, the surgeon is sometimes obliged to pass deeply among important vessels and nerves, which must, of course, not be interfered with. In conducting such an operation about the neck, the precaution must be used of preventing the entrance of air into the veins. The bleeding which attends the excision of the cicatrice is generally trifling, and is easily arrested by torsion: when the ligature is unavoidable, it should be brought out at the nearest point of the wound, or through a small opening in the transplanted integument.

The skin for filling up the gap left by the removal of the inodular tissue, should always be taken from the immediate vicinity of the part. Thus, in the neck, it is usually obtained from the shoulder or top of the chest, and, when the wound is very large, two flaps are generally made, one on each side, the object being to guard against sloughing from inadequate nutrition. Due allowance must always be made for shrinkage. Hence, the flap should invariably be at least from one-fourth to one-third larger than the wound, have a good broad pedicle, and be well stitched in its new position, although care must be taken not to place the sutures too near each other for fear of embarrassing the circulation. The central portions of the flap must be loosely confined with adhesive strips, and the edges covered with charpie, soaked in oil. The wound made by the transplantation of the integument is immediately closed in the usual manner. The parts are kept perfectly at rest, being immovably fixed by suitable apparatus, and the case is afterwards managed according to the general principles of plastic surgery.

The results of this operation have been much lauded; I have not, however, I must confess, much confidence in its ultimate efficacy, experience having taught me that, sooner or later, the deformity is sure to return, though not always in its original extent. I have seen enough of these procedures, both in my own practice and in that of others, to convince me that they ought not to be classed among the triumphs of surgery. It is only when the cicatrice is very soft and superficial that they hold out any prospect of a very favorable result. When the contraction affects the muscles, tendons, fibrous membranes, and bones, forcing them out of their natural shape and position, the art of surgery can be of no avail.

Joints often become involved during the progress of burns and scalds, either from direct inflammation, or in consequence of the contraction of neighboring muscles, tendons, and aponeuroses. The parts are carefully watched, being moved from time to time, and constantly retained in splints, until all tendency to anchylosis has ceased.

Finally, the secondary *constitutional irritation* and drainage, so common, and so hazardous in the more severe forms of these accidents, must be met by stimulants, tonics, and anodynes, along with a nutritious diet, and exercise in the open air. The wasting diarrhœa, which is so often present, must be checked with opium and astringents, of which acetate of lead and sulphate of zinc deserve particular mention, the former being given in two, and the latter in one grain doses, with half a grain of opium, three times in the twenty-four hours. Night-sweats are controlled with quinine and elixir of vitriol.

Secondary amputation may be rendered necessary, when, an attempt having been made to save the part, death is likely to happen from the excessive discharge and hectic irritation; or when the part is found not only to be useless but to be greatly in the way of the patient's comfort and convenience.

SECT. VI.—FROST-BITE AND CHILBLAIN.

Man, as is well known, possesses in an eminent degree the faculty of resisting the influence of physical agents. His constitution is able to bear almost any amount of heat and cold, provided the transition from the one to the other is not too great or sudden, and that he himself is at the time in the full enjoyment of his bodily powers. The experiments of Fordyce, Blagden, and others, show what an amount of artificial heat may be endured without entailing any serious effects, and the experience of travellers, as Banks, Solander, and Kane, is equally decisive in regard to his capacity of withstanding the effects of low degrees of temperature. It is only, or chiefly, when the alternation from heat to cold is very rapid, or when the application of cold is made in a very concentrated form, upon a part of the body whose circulation is naturally very languid, that severe consequences are apt to ensue. Baron Larrey, who enjoyed extraordinary opportunities of studying the effects of cold, during Bonaparte's celebrated retreat from Russia, was forcibly struck with the little suffering which the soldiers experienced when exposed even for several successive days to the influence of a very low, dry, uniform temperature. Thus, after the battle of Eylau, although the mercury had fallen fifteen degrees below zero of Réaumur's thermometer, none of the French troops complained of frost-bite, notwithstanding many of them had remained in the snow, in an almost inactive state, for upwards of twenty-four hours. Presently, however, a fall of sleet coming on, during which the temperature rose suddenly from eighteen to twenty degrees, immense numbers of those who had been exposed began to suffer from the effects of cold, consisting principally in sharp, pricking pains in the remote parts of the body, especially in the feet, and in a disagreeable sense of numbness and weight. Severe swelling soon followed; the skin assumed a dusky, reddish appearance; the joints became stiff and insensible; feeling and warmth rapidly diminished; and black spots formed on the roots of the toes and on the back of the foot, announcing the occurrence of gangrene, the extremity looking dry and shrivelled, as in chronic mortification. It was observed that those who had warmed themselves at fires suffered more severely than those who had been more discreet in this respect.

Frost-bite was very prevalent among the English troops during their first winter in the Crimea, and the French suffered in still larger numbers, as well as more severely. The habit which the men had of sleeping in their wet boots, at one time almost universal, contributed greatly to its production, wet and cold combined diminishing the circulation and vitality of the feet and toes. On the 21st of January, 1855, when, according to Dr. Macleod, the thermometer stood at 5°, no less than 2500 cases of frost-bite were admitted into the French ambulances, and of these 800 died, death in many having no doubt been expedited by the effects of erysipelas, pyemia, and hospital gangrene.

The first effect of dry, cold air is a sense of numbness and weight with a peculiar prickling or tingling, and an afflux of blood to the surface, giving it a lively reddish appearance. If the impression be maintained for any length of time, the parts become stiff and perfectly insensible; and the blood, retreating from the surface, leaves it of a pale, whitish aspect, contrasting strikingly with the previous discoloration. When the cold is intense, and suddenly applied, so as speedily to overwhelm the parts, the surface occasionally exhibits a mottled appearance, depending upon the presence of coagulated blood in the subcutaneous veins.

The effects of moist cold are very similar to those of dry cold. Upon immersing the hand, for instance, in iced water, there is generally an immediate rush of blood to the surface, and a decided augmentation of its color, soon succeeded by an unpleasant tingling sensation and a marked degree of numbness. By and by, however, the surface becomes white, the skin contracts, exquisite pain arises, and the whole limb sensibly shrinks. There is thus, in fact, no essential difference in regard to the effects of these two varieties of cold; and the reader cannot fail to observe how closely the first impressions of both resemble those produced by the application of artificial heat, especially in its dry form.

All parts of the body are liable to suffer from the effects of cold; excepting, however, those rare cases, where the impression has been maintained for an unusual length of time, the toes, feet, heels, fingers, hands, nose, and ears, together with the lips and cheeks, will be found to be more frequently affected than any other parts. Accidents of this description are most common among the poorer classes, those wretched beings whose system is broken down by starvation, intemperance, and every kind of exposure and hardship, calculated to depress the vital powers, and predispose to the development of disease. Sailors and the boatmen on our lakes and rivers are particularly prone to frost-bite, and there are few seasons that do not furnish a large supply of such cases.

The primary effects of cold upon the general system are those of an agreeable stimulant; the circulation is increased in force and frequency, a slight glow pervades the surface, and the individual is universally exhilarated. By and by, this agreeable feeling is changed into one of pain and torpor; the brain is oppressed as if under the influence of a powerful narcotic; the whole body is cold and benumbed; and the person, overwhelmed by drowsiness, is obliged to make the most powerful efforts to keep awake. If, in an unlucky moment, he should yield to his inclinations, away from friends and assistants, he sleeps to wake no more; the blood rapidly settles in the internal organs; the nervous fluid ceases to be generated; the respiration becomes heavy and stertorous, and death takes place very much as in ordinary apoplexy. Should the individual, after long and severe exposure, be suddenly brought into a hot room, or placed near a fire, he will run the risk of speedily perishing from asphyxia, brought on by the repulsion of the blood to the brain and lungs; or, should he survive a short time, the frost-bitten parts will be seized with gangrene, the spread of which, as observed by Larrey, is often so rapid and striking as to be perceptible by the eye.

Such are some of the more important local and constitutional effects of cold, when applied in its more severe and protracted forms. As just seen, it may prove destructive both to the part and system, or, reaction taking place, the patient may recover, although he will be likely afterwards to suffer more or less in various parts of the body, especially the feet, ears, nose, and fingers, from the secondary effects of his accidents, which are often as distressing to him as they are perplexing to the practitioner.

The *treatment* of frost-bite requires no little judgment and adroitness to conduct it to a successful issue. The great indication is to recall the affected parts gradually to their pristine condition by restoring circulation and sensibility, in the most gentle and cautious manner, not suddenly, or by severe measures. The first thing to be done is to immerse the part in iced-water, or to rub it with snow, the friction being made as carefully and as lightly as possible, lest over-action be produced in a part necessarily greatly weakened. If no ice or snow be at hand, the coldest well water that can be procured must be used; and if immersion be inconvenient, wet cloths are applied, with the precaution of maintaining the supply of cold and moisture by constant irrigation. Moderate reaction is aimed at and fostered. All warm applications, whether dry or moist, are scrupulously refrained from; the patient must not approach the fire, immerse his limbs in hot water, or be even in a warm room. Attention to these precepts is of paramount importance, and should on no account be disregarded, since its neglect would be almost certainly followed by mortification or other disastrous consequences.

As soon as the natural temperature has been in some degree restored, slightly stimulating lotions will be found serviceable, such as weak solutions of camphor, soap liniment, or tincture of arnica with the addition of a few drops of ammonia to each ounce of fluid. The parts are placed at rest, in an easy and rather elevated position, and lightly covered with a blanket, or, what is better, exposed to the warm air of the apartment, there being now no longer any necessity of keeping the patient in a cool room, as there was in the earlier stages of the treatment. Some mild cordial may now also be given in small quantity, and the patient may eat a little warm gruel or panado. If the local reaction threaten to be severe, it must be checked by astringent and cooling lotions, by attention to position, a properly regulated diet, and the exhibition of a purgative. For incipient mortification, consequent upon cold, the best remedy is dilute tincture of iodine.

Dr. Hayes, the companion of Dr. Kane in his last Arctic voyage, gives an account of a mode of treatment of frost-bite pursued by the Esquimaux, which deserves brief mention, although it does not differ essentially from that just laid down. A native, says the writer, who had his leg frozen above the knee, to such an extent that it was stiff, colorless, and apparently lifeless, was placed in a snow-house at a temperature of 20° below zero. The parts were now bathed with ice-cold water for about two hours, and then enveloped in furs for about twice that period. At the end of this time frictions were commenced, first with the feathery side of a bird skin, and then with snow, alternately wrapping the limb in furs, and continuing the rubbing for nearly twenty-four hours. The limb was now carefully covered, and the temperature of the room elevated by lamps above zero. On the third day the man was removed to his own house, and in seventy hours he was able to walk about, with only a slight frost-bite on one of his toes.

When a person has been overpowered by cold, or is nearly frozen to death, the attempts at restoration must be conducted upon the same general principles as when he is suffering merely from the local effects of cold; that is, he should be put in a cool room, and be gently but efficiently rubbed with flannel, wet with brandy, spirits of camphor, or ammoniated liniments, gradually followed by dry frictions and warm covering. If he can swallow, brandy should be given by the mouth, or this or some similar article should be thrown into the rectum; stimulants should be cautiously applied to the nose, especially snuff, and sinapisms to the precordial region, the stomach, and spine. As the circulation and respiration improve, the temperature of the apartment may be gently elevated, and warm broths, or wine-whey, or, what is better, warm toddy, administered. The efforts at resuscitation should not be discontinued too soon, since they have occasionally been crowned with success long after all reasonable expectation of recovery had ceased. The practice formerly recommended of immersing the whole body in cold water, under these circumstances, cannot be too much deprecated, as it cannot fail to prove exceedingly injurious.

Pernio or *chilblain.*—The secondary effects of cold are usually described under the name of pernio or chilblain, and there are several varieties of form in which they may present themselves, as the erythematous, ulcerated, and gangrenous. These effects may supervene upon slight exposure, and hence they are occasionally met with among our better class of citizens, the parts most liable to suffer being the toes, heel, instep, ears, nose, and fingers. They are usually preceded by slight vesication, and by burning, tingling sensations, as if the surface had been held near the fire. These effects may soon subside, or they may prove a source of annoyance for many months; in general, however, they are of a transient nature, but the parts, instead of getting completely well, remain weak and congested, and are liable to new attacks of suffering from the slightest causes. Any sudden change in the weather is extremely prone to bring on a paroxysm; the affected structures become red, or of a dusky purplish hue, swollen, painful, and œdematous; the epidermis is often raised into little blisters, distended with yellowish, or sanguinolent fluid; and there are few cases in which itching, sometimes almost insupportable, is not a prominent symptom, the patient feeling as if he could tear the parts to pieces.

Ulcers not unfrequently form, as an effect of frost-bite; generally preceded by slight vesication, they are superficial, irritable, and indisposed to heal, the discharge being of a thin, ichorous character; the parts around are red, inflamed, and congested, and the erosive action often spreads over a considerable surface. In some cases it extends very much in depth, and may thus ultimately invade a neighboring joint, bone, tendon, or muscle.

Gangrene is more frequently a primary than a secondary effect of frost-bite; the affected part is of a dark brownish, or blackish color, cold, insensible, and exquisitely fetid; in some cases the slough is dry and shrivelled, like a rotten pear, in others, it is moist and expanded. In persons of weak constitution, and in the more remote parts of the body, where the circulation is naturally very feeble and languid, it often spreads to a considerable extent; but in general its tendency is to limit itself to a small space. When considerable, it may invade all the component tissues of a limb, the soft parts as well as the bones and joints.

Pernio may, as already stated, last for many years, alternately disappearing and recurring under the slightest local and constitutional changes. Atmospheric vicissitudes generally exercise a marked influence upon these attacks, the patient being often a complete barometer; a combination of cold and moisture is particularly prejudicial. During the dry weather of summer the disease not unfrequently goes off spontaneously, but is sure to return on the approach of winter. In this manner life may be rendered perfectly miserable, especially when the chilblain is seated in the feet, the patient being hardly ever able to walk about with any degree of comfort or satisfaction.

The *treatment* of pernio is generally too little regarded by the practitioner, who, knowing that it never endangers life, is too apt to overlook its just claims to his sympathy. Of the various remedies that have been, from time to time, recommended for its relief, those that are of a slightly stimulating character are most entitled to confidence. The milder forms of the disease may often be promptly relieved by immersion of the part in cold, or ice water, followed by a pretty strong solution of acetate of lead and opium, or, what is preferable, the dilute tincture of iodine, which, on the whole, I have found to be more beneficial than any other article. Sometimes prompt relief follows the application of carded cotton, soap liniment, spirits of camphor, or some other stimulating embrocation.

When blisters form they should immediately be opened, and the affected surface freely touched with solid nitrate of silver, or painted with tincture of iodine. Not unfrequently excellent effects follow the use of the dilute citrine ointment, or ointment of the oxide of zinc. In obstinate cases I have derived great advantage from a blister, retained until thorough vesication was produced.

The gangrenous form of pernio must be treated upon general principles. Fetor is allayed by the chlorides, and sloughs are removed as they become detached. Amputation is refrained from until there is a well-marked line of demarcation.

In all cases proper attention must be paid to the general health; the diet must be regulated, the bowels evacuated, and the secretions improved and restored. There is reason to believe that great temporary suffering is often induced by neglect of these precautions.

SECT. VII.—MORBID GROWTHS.

The skin is subject to a variety of morbid growths, some of a benign, others of a malignant character. Among the more simple formations belonging to the former class are warts, corns, horny excrescences, and the so-called sebaceous tumor, which, as its name implies, has its seat in the sebaceous follicles, so common in different regions of the cutaneous surface. Fibrous, fibro-cellular, or fibro-plastic growths are also sometimes met with, although they are infrequent; they are never malignant, but are extremely apt to return after extirpation. The most common and interesting development of this description is what is termed the keloid tumor, incidentally referred to in the chapter on the general history of morbid growths. Finally, the skin is occasionally remarkably hypertrophied, either congenitally, or as a result of interstitial deposits.

The number of malignant growths of the cutaneous tissues is quite considerable, and, as they are of frequent occurrence, and often followed by disastrous consequences, it becomes necessary to study them with more than ordinary care and attention. The principal affections, recognized by pathologists, as appertaining to this class of diseases, are scirrhus, melanosis, eiloid, lupus, epithelioma, and the peculiar bark-like formation first described by Dr. Warren under the name of lepoid.

1. WARTS OR VERRUCOUS GROWTHS.

Warts are those peculiar excrescences, or prominences, so often seen upon the hands and face of young persons, although the old are by no means exempt from them. They consist essentially of a hypertrophous condition of the papillary structure of the skin, and sometimes occur in such numbers as to constitute a genuine verrucous diathesis. When this is the case, they are not only developed with remarkable rapidity, but are apt to attain an extraordinary size. Of the exciting causes of warts, nothing is known; they often occur in several members of the same family, and instances are observed in which they betray a hereditary tendency.

A wart is a hard, insensible excrescence, generally of a conical shape, more or less movable, and attached by a broad base, although sometimes the reverse is the case, the union being effected by a very narrow pedicle; its surface is rough, fissured or tuberculated, and usually a few shades darker than the adjacent skin; its size seldom exceeds that of a common pea. When cut, it is painful, and bleeds somewhat. Its structure is essentially cellulo-fibrous. The fluid which follows a section of a body of this kind, has been supposed, but erroneously, to be contagious, or inoculable. A wart on the face, arm, or shoulder sometimes becomes the seat of carcinoma, especially when it is constantly rubbed or irritated

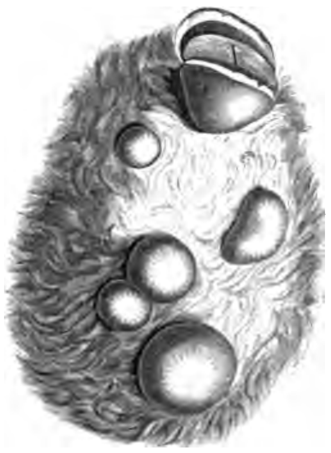
The *treatment* of warts is very simple. In young persons, in fact, they often disappear spontaneously. The best local remedy is chromic acid, with equal parts of water, applied with a glass brush. It instantly turns the skin black, and forms an eschar, which drops off in six or eight days, leaving a healthy, granulating sore, which soon heals. Tincture of iodine, acetic acid, bichloride of mercury, and sulphate of copper, also, answer an excellent purpose. When a verrucous diathesis exists, recourse must be had to the exhibition of arsenic, or Donovan's solution. Excision is necessary when a wart displays a tendency to malignancy.

2. SEBACEOUS TUMORS.

The sebaceous tumor, essentially consisting of an enlargement of a sebaceous gland with a retention of its secretions, has been described under various names, founded either upon the character of its walls, the fancied nature of its contents, or the kind of structure in which it originates; as encysted, atheromatous, meliceric, steatomatous, and follicular. Wen was the familiar appellation by which it was known by the older surgeons. The term sebaceous, being expressive of the true situation of this variety of tumor, seems to me to be preferable to any other, and I shall therefore retain it on the present occasion.

The manner in which the sebaceous tumor is formed is easily explained. The first link in the morbid chain is the obstruction of a sebaceous gland, or cutaneous follicle, either in consequence of adhesive inflammation, or the inspissated condition of its own secretion, thereby offering a mechanical impediment to its escape. Being thus forcibly retained, the matter gradually increases in quantity, and as it does so it necessarily presses everywhere upon the walls of the gland, which, in time, expands into a strong sac, fig. 187, varying in size from that of a pea up to that of a small orange. Essentially, then, the tumor is an encysted tumor, consisting of an enlarged or hypertrophied condition of the sebaceous gland, and of an altered state of its own secretion, both the direct and inevitable result of the closure of the natural outlet preventing the evacuation of the affected structure.

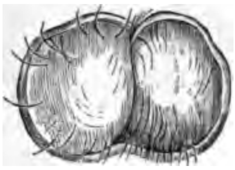
Fig. 187.



Sebaceous tumors of the scalp; one at *a* being laid open to show its cyst and contents.

The *contents* of the sebaceous tumor are extremely variable, both in color and consistence; in general, they are thick and whitish, looking and feeling very much like a mass of lard or tallow; occasionally they present the appearance and consistence of honey; and cases are met with in which they bear a very close resemblance to putty, or a thick mixture of flour and water. Sometimes the contents of a tumor of this kind are thin, almost watery, and exceedingly offensive. At other times, again, short hairs, very soft, and having well-formed roots, are found in them, as represented in fig. 188.

Fig. 188.



Cyst of a sebaceous tumor, with hairs in its interior.

Pilous matter is most commonly found in sebaceous tumors about the forehead and eyelids. I have repeatedly seen it in these situations, and in several instances in very young subjects. It is not likely that the hairs that are found here are developed in the morbid growth; on the contrary, the probability is that they are intercepted during the process of occlusion of the cutaneous follicle, and that, after they have fallen into the cavity of the cyst, they are capable of attaining a certain development, but ultimately cease to grow, and so become effete matter.

The sebaceous tumor sometimes contains calculous matter, either in part or in whole; consisting of phosphate and carbonate of lime, cemented together by a minute quantity of animal substance. A case has been recorded where the integuments of the buttocks were completely studded with small collections of this description; they occurred in a young lad, and evidently had their seat in the skin-follicles. Similar formations have been observed on the forehead, scalp, nose, shoulders, trunk, and scrotum.

The *cyst* of this variety of tumor, at first very thin, soft, and delicate, becomes, in time, quite thick and dense, often resembling a fibrous membrane; and instances are occasionally met with, although they are rare, in which it is transformed into fibro-cartilage, cartilage, and even bone. In cases of long standing, its thickness is sometimes very remarkable. Externally the cyst is rough, and more or less intimately connected with the surrounding parts by cellular tissue, which is not unfrequently considerably condensed; internally, on the contrary, it is generally smooth and glistening, very much, for example, like the inner surface of the dura mater. Small sacs are sometimes observed in its interior, and I have several times seen indistinct partitions thrown across it, the result, apparently, of plastic, organized deposits.

The sebaceous tumor has but few vessels, and even these are always very small; hence its progress is invariably tardy, and its removal is never attended with any hemorrhage. Little or no pain accompanies its development, and it never manifests any malignant tendency. Sometimes, however, it ulcerates, and becomes the seat of a good deal of local irritation and of a highly disagreeable, offensive discharge. When seated on the scalp, the steady, persistent pressure of such a tumor may occasionally partially indent the osseous tissue, as I have seen in several instances that have fallen under my observation. Although the diseased follicle is originally situated in the substance of the skin, the cyst, as it increases in size, gradually pushes itself beneath it, so that the connection between them is ultimately completely destroyed. Meanwhile, the skin itself becomes attenuated, and often, in great measure, deprived of hair, especially when seated on the scalp, where, particularly in cases of long standing, the surface is often quite bald.

The degree of *mobility* of the morbid growth is extremely variable, depending upon its age and volume, but, above all, upon the amount and laxity of the cellular tissue in the structures in which it is developed. Its shape is for the most part globular; but when it is subjected to considerable pressure, it is not uncommon for it to have a compressed, flattened appearance.

The most common *sites* of the sebaceous tumor are the face, forehead, and scalp. It is also met with on the neck, eyelid, shoulder, back, buttock, and scrotum. On two occasions I have seen it on the prepuce, the patients being small boys who had been circumcised at the usual period at which that operation is performed according to the rites of the Jewish Church. It is very seldom that the sebaceous tumor is found on the extremities.

The *number* of sebaceous tumors, although usually small, is extremely variable. Sometimes there is only one, but it is not at all uncommon to see as many as five or six on the same person. In one instance, that of a man aged forty, I counted upwards of two hundred, most of them being situated upon the head, face, and neck. Nearly all began when he was quite young, soon after bathing in cold water. They were of the meliceric kind, the contents of many being visible at the enlarged and partially obstructed follicle, where they had concreted, and presented a yellowish, dirty, wax-like appearance. They were of a globular or ovoidal shape, and varied in volume from that of a pea up to that of a hen's egg.

Occasionally these tumors occur in several members of the same family; and now and then they display an evident *hereditary* tendency, as in a case which fell under my observation in 1844, in which the disease existed upon the scalp of a young woman of twenty-seven, and also upon that of her father, a paternal aunt, and her paternal grandmother. The tumors were, respectively, from four to seven in number, and varied in volume from that of a marble to that of a walnut. More recently two other instances of a nearly similar character have come under my notice.

The *diagnosis* of the sebaceous tumor is sufficiently easy. Its chronic march, indolent character, soft, doughy consistence, mobility, and subcutaneous situation, together with the absence of enlargement of the subcutaneous veins, and the normal appearance of the skin, always serve to distinguish it from other morbid growths.

The only *remedy* for this variety of tumor is thorough excision, care being taken that not a particle of the cyst or wall be left behind, otherwise repullulation, to a greater or less extent, will be inevitable. If the tumor be situated upon the scalp, a single longitudinal incision may be made across it, the flaps being dissected off from each side, and the morbid mass lifted out bodily, without exposing its contents. In most other regions, however, the best plan is to lay the tumor open from within outwards, turn out its contents, and then tear away the cyst. When the integuments are diseased, it may be proper to include the altered structures in an elliptical incision. However performed, the operation should never be undertaken without some preparation of the system, as I have repeatedly known it to be followed by erysipelas.

3. MOLLUSCOUS TUMORS.

There is a form of cutaneous tumor, to which, from its fancied resemblance to the knots on the bark of the maple, the term molluscous has been applied. When fully developed, it is about the size of a ripe currant, which it further resembles by having a central depression upon its surface, caused by the peculiar arrangement of its contents. Their form is variable; some are round or oval, some elongated, and as if compressed, some pedunculated, and some wallet-shaped. In color, they are usually red, reddish-brown, or dusky yellowish; in consistence, soft and spongy.

Molluscous tumors occur upon various parts of the body, as the face, neck, back, shoulders, nates, and extremities, and often exist in such immense numbers as to constitute a genuine molluscous diathesis. What is singular is, that they are sometimes met with in several members of the same family; a circumstance which, together with their rapid and consentaneous development, has led to the idea of their being occasionally contagious, or communicable from one person to another by contact. Whether this, however, is really so or not remains to be proved.

The disease, although it has been noticed at a very early period, as in children under five years of age, is most common in adult and elderly subjects. Its progress is frequently very rapid, a large portion of the surface becoming studded with tumors in a few weeks. How the disease is excited we are uninformed, nor is anything known of its predisposing causes. The immediate influence under which it is developed is inflammation of the sebaceous glands, giving rise to a rapid secretion of sebaceous matter, which, becoming too thick to escape at the natural outlets, accumulates in the interior of these reservoirs, pressing asunder their walls, and giving them a lobulated appearance, as is rendered evident on a section of them.

The *contents* of these little tumors consist mainly of epidermic scales, in union with ovoid, oblong, or cuboid cells, heaped together like a pile of eggs, and occupied either by granular matter, oil globules, or a peculiar homogeneous substance, of whose nature we are ignorant.

Left to themselves, molluscous tumors nearly always pass into ulceration, generally beginning at their summits, and gradually progressing until their contents are completely discharged, when the parts usually readily heal; or they are invaded by gangrene, which occasionally extends deeply into the subjacent tissues, and thus leads, in the event of recovery, to disfiguring scars. Finally, cases occur in which the tumors become atrophied, or transformed into little pendulous wart-like excrescences.

The *treatment* of these molluscous formations is best conducted by the topical use of stimulants, of which the most efficacious are tincture of iodine, acid nitrate of mercury, sulphate of copper, chloride of zinc, and chromic acid, all more or less diluted to adapt them to the exigencies of each particular case, or the tolerance of the parts, the object being rather to produce a sorbefacient than an escharotic effect. In general, it will be found that brushing the surface of the tumor over freely once a day with the tincture of iodine will not only promptly arrest its development, but rapidly promote its removal. Laying open the morbid growth, and touching the raw surface slightly with the solid nitrate of silver, is a plan highly recommended by some practitioners. The most expeditious method of all, however, is to cut it away with the knife, or to effect its strangulation with the ligature; but it is obvious that such a procedure can only be adopted with any degree of propriety when the number of tumors is very small.

Constitutional treatment is not to be neglected in this disease. Occasionally the molluscous tumor in great degree, if not entirely, disappears, simply under the influence of a change of air, a judiciously regulated diet, and attention to the bowels and secretions. When the general health is much disordered, the first object should be to amend it by the interposition of suitable remedies, medicinal and hygienic. Cleanliness is of great importance, and must not be overlooked. If there be a scorbutic state of the blood, iron and quinine, with sub-acid drinks and vegetables, will be indicated.

4. MOLES.

Moles are congenital spots, occurring upon various portions of the external surface of the body, usually of a dark, grayish, blackish, tawny, or brownish color, and closely covered with short, thick, almost bristly hairs. They occasionally project somewhat above the surrounding level, but in general this is not the case; they are usually a little harder than the natural skin, and they present themselves in various forms, of which the round and oval are the most common. Some persons seem to be remarkably prone to the formation of moles, and when this is the case it is not uncommon to see a number of them scattered over different parts of the body. When single, or existing in small numbers, they generally occur on the face, shoulder, neck, or arm. Their size varies from that of a three-cent-piece to that of a dinner-plate.

The color of these spots is due to a redundant deposit of the natural pigment of the mucous network of the skin, with an altered condition of the proper substance of the dermis, and probably also of the cuticle and of the hair follicles.

Long-continued local irritation, such as is caused by friction, pressure, or the want of cleanliness, may occasionally awaken ulceration in these bodies, but in general they remain perfectly stationary and innocuous. A few years ago, I excised a mole from the back part of the arm of an old gentleman, of upwards of eighty, which had been a source of annoyance to him, more or less, for thirty years. It had latterly become ulcerated, had often bled, and was the seat of a very fetid, nasty discharge. It was included in an elliptical incision, the parts healing kindly, and there being no return of the disease.

It is not often that moles become the subjects of surgical interference; it is only, in fact, when they cause serious disfigurement, or when they fall into ulceration, that professional aid is sought. It has been proposed to get rid of them by mild caustic applications, as solutions of ammonia or caustic potassa; but as such a procedure might be followed by the development of keloid, the best plan always is to remove them with the knife, the morbid structures being included in an elliptical incision, the edges of which are afterwards healed, if possible, by the first intention.

5. HYPERTROPHY OF THE SKIN.

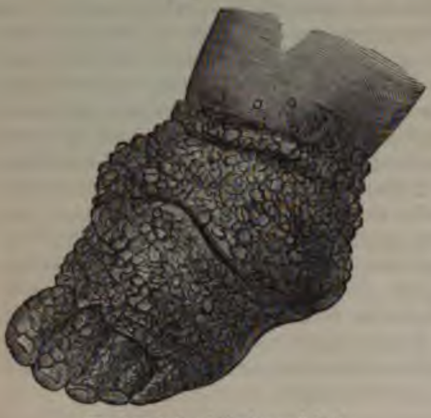
Hypertrophy of the skin is now and then observed, chiefly, if not exclusively, as a congenital affection. It is characterized by a soft, pendulous condition of the skin, which hangs off in loose folds from the surface to which it is naturally attached, as if it had been stuck on without any special object. In all other respects, the integument is apparently perfectly normal, there being not the slightest alteration of color, consistence, or structure, at least so far as we are enabled to judge from inspection. The most common sites of hypertrophy of the skin are the nates, scrotum, prepuce, and vulva. The most remarkable example that I have met with occurred on the back of the neck in a female child, upwards of a year old, as the result of a congenital vice; the integument formed a large pendulous mass, of a doughy, inelastic feel, extending from ear to ear, aud causing a very unseemly deformity. The child was in other respects well formed, and, with this exception, remarkably beautiful.

When the hypertrophied integument forms an unsightly mass, or when it proves inconvenient by its bulk, the surgeon will be appealed to for advice, and under such circumstances it may become necessary to remove the offending structures. For this purpose, the parts should, if possible, be included in an elliptical incision, care being taken not to cut away so much of the skin as to interfere with reunion. If the tumor be very large, and the patient of tender age, recourse to the knife should be postponed until the constitutional stamina are sufficiently developed to enable the child to bear the shock attendant upon so severe an operation. Special pains should be taken to guard against hemorrhage.

6. ELEPHANTIASIS, OR HYPERTROPHY OF THE SKIN AND CELLULAR TISSUE.

Arabian elephantiasis, Egyptian sarcocele, or the glandular disease of Barbadoes, as it is variously denominated, although uncommon in this country, deserves passing notice not less on account of the hideous deformity which it induces than its obstinate and intractable character. The favorite seat of this singular disease is the leg, which often acquires an enormous volume and a most grotesque appearance, causing a striking resemblance to the leg of the elephant, whence its name. It is not, however, confined to this part of the body; on the contrary, it is liable to occur in various organs, particularly the scrotum, prepuce, and pudendum, which, in consequence, sometimes acquire an enormous bulk. A tumor of this kind, presented to me by Dr. Bozeman, and removed by him from the genital organs of a negro, weighed forty pounds; and Clot-Bey extirpated one, occupying a similar situation, which weighed one hundred and ten pounds. The adjoining cut, fig. 189, affords an illustration of this disease as it manifests itself in the foot and leg.

Fig. 189.



Elephantiasis of the leg and foot.

The disease is met with in both sexes, but much oftener in men than in women; it occurs in various races of men, and frequently begins at an early age, although it is most common in young adults. In this country and in Europe the affection is very rare, but in certain parts of Asia, Africa, Syria, Arabia, Egypt, and the West Indies, it is extremely prevalent and sometimes observes an endemic tendency.

Of the *causes* of elephantiasis nothing satisfactory is known. The disease is evidently of an inflammatory character, but how this is brought about we are entirely ignorant. It has been supposed that it is owing to an obstruction of the principal veins of the affected parts, impeding the return of blood, and thus creating congestion and irritation, followed by plastic exudation in the interstices of the cutaneous and cellular tissues. From the fact that attacks of erysipelas are not uncommon in the earlier stages of the disease, or, rather, that this affection not unfrequently precedes the outbreak of elephantiasis, it has been imagined that it is essentially dependent upon the disturbance which it occasions in the nutritive and secretory functions of the parts. Others, again, have been led to conclude that the malady essentially consists in an inflammation of the lymphatic vessels, attended with plastic deposits within and around these vessels, whereby their caliber is choked up, and, as a necessary consequence, their contents are prevented from discharging themselves into the thoracic duct. This view is, on the whole, extremely plausible, for it really comprises all the cardinal elements of a consistent theory, which the others certainly do not. That there is, in this disease, serious mechanical obstruction of some kind or other, is unquestionable, and I know of none that would be more likely to produce such a result than compression of the lymphatic vessels. If, then, it is allowable, in the existing state of the science, to frame a doctrine in respect to the origin of an affection so obscure as elephantiasis is acknowledged to be, we may conclude that it is an inflammation of the absorbents, attended with obstruction of their caliber, and deposits of plastic matter, which, becoming gradually organized, is ultimately converted into an analogous fibrous tissue, thereby completely changing the character of the primitive structures, especially the cutaneous and cellular.

If the affected structures be carefully examined by *dissection*, the following appearances will be observed: The epidermis is very much thickened, rugose, and so firmly adherent as to come off with difficulty. The true skin is of a whitish color, striated in its texture, and very hard and dense, cutting almost like the rind of bacon. In many cases it is from a quarter of an inch to half an inch in thickness. The papillæ are enormously hypertrophied, and of an elongated shape, forming large bodies which stand off prominently from the substance of the true skin. The cellular tissue is completely changed in its character; its areolæ are obliterated, and their place is supplied by a dense, inelastic fibroid substance, exhibiting none of the properties of the original. In elephantiasis of the leg, the muscles, compressed by the new matter, and deprived of activity, are found to be wasted, pale, and in a state of fatty degeneration. The bloodvessels are generally very much enlarged, and hence, when an attempt is made to extirpate the morbid mass, as when it occupies the genital organs, tremendous hemorrhage is to be expected. In some cases, however, the larger veins are obliterated, especially in elephantiasis of the lower extremity. The principal nerves have a white, flattened appearance, and are apparently augmented in size.

Elephantiasis often, if not, indeed, generally, comes on suddenly and unexpectedly, without any apparent local or constitutional cause. At times, however, its development is directly traceable to local injury, as a blow, sprain, or contusion; and in quite a number of cases it has seemingly followed upon the protracted immersion of the parts in cold water, the occupation of the individual compelling him to pursue such a habit. The symptoms are at first of an inflammatory character; the affected surface, red and painful, pits on pressure, and imparts a nodulated, cord-like sensation to the finger; the subcutaneous cellular tissue is hard and infiltrated; and the movements of the diseased structures soon become stiff, awkward, and embarrassed. Sometimes red lines or streaks extend along the course of the lymphatic vessels, as high up as the nearest ganglions, which are themselves more or less tender and swollen. Considerable febrile commotion is generally present, but this soon subsides, and the disease gradually lapses into a chronic state, which often ceases only with the patient's life.

The *diagnosis* of elephantiasis is unmistakable; there is no other affection which bears any resemblance to it. Once seen, it can never be forgotten. The part is not only enlarged, but enormously increased in weight and consistence; it feels heavy and cumbersome, and is as hard, dense, unyielding, and rough as the leg of the animal from the resemblance to which it has derived its name. The surface of the skin, usually much darker than natural, is fissured, grooved, nodulated or tuberculated, and completely deprived of its normal sensibility. Sores occasionally form upon it, and, gradually spreading in diameter and depth, add greatly to the local distress. Sometimes small, hard, shining scabs exist, not unlike those of ichthyosis. The chronic march of the disease, the remarkable deformity of the affected parts, and the peculiar condition of the skin will always prevent it from being confounded with anasarca, the only lesion which bears any resemblance to it.

The disease, once fully established, may remain completely stationary for years, or even during the remainder of life, or it may go on gradually increasing until the affected parts have acquired a volume and a weight many times beyond the natural state. Even under these circumstances, however, the suffering is chiefly of a mechanical character; the general health often continuing good to the last. It is only, in fact, when intractable ulcers form, and there is an abundant discharge of pus, that the constitution is likely to give way under the local drain and irritation. The prognosis is of course most unfavorable in those countries where the disease is endemic; in Europe and the United States, where it occurs only as a sporadic affection, very few die of it.

The *treatment* of elephantiasis is, at best, very unsatisfactory, however early it may be commenced, or however perseveringly and judiciously it may be conducted. Regarding it as essentially consisting in an inflammation of the lymphatic vessels, or of these vessels and the veins, the most rational plan of treatment that suggests itself is the antiphlogistic, of which leeching, blistering, and the application of tincture of iodine are among the more important and reliable means. The object, in the first instance, should be to reduce local action, and thereby prevent subversion of structure. Hence the sooner these remedies are applied the more likely shall we be to obtain resolution. As a sorbefacient, there is no article in the whole materia medica that holds out such strong hopes of relief as tincture of iodine, used either pure or variously diluted to suit the exigencies of each particular case. It not only promotes the removal of effused fluids, but produces a powerful revulsive and antiphlogistic action, and should be employed, steadily and persistently, for many months together. The effects of the treatment will be greatly augmented, if, superadded to it, the parts be occasionally scarified, to relieve engorgement, kept at rest in an elevated position, and well bandaged, strapped, or mechanically compressed. Inunction with mild mercurial ointment also sometimes proves beneficial; and, in the earlier stages of the complaint, lotions of acetate of lead, hydrochlorate of ammonia, and of rectified spirits, are worthy of trial, especially when there is much pain, with a tendency to rapid effusion and organization.

Constitutional treatment is not to be disregarded in this disease. It will, in general, greatly assist the action of local remedies if the patient be put under proper restraint in respect to his diet, if he take occasionally a brisk cathartic, and if he be kept pretty constantly under the influence of the saline and antimonial mixture, with a few grains of calomel every night at bedtime, until slight ptyalism is produced. General bleeding might even be advantageously employed at the beginning of the treatment, if there be a robust and plethoric state of the system.

When the malady has attained an extraordinary degree of development, or has gone on for many years progressively increasing, or has remained stationary for a long time, no treatment of which we have at present any knowledge, not even ligation of the principal arteries of the affected tissues, will be likely effectually to eradicate the disease, or, more properly speaking, enable the parts to resume their primitive condition. All topical and general means are, under such circumstances, absolutely unavailing; and the utmost that can reasonably be expected from cutting off the supply of blood to the part is a diminution of its size, not a complete restoration of it to health. Professor Carnochan deserves great credit for the laudable effort which he has made, in several cases of elephantiasis of the leg, to arrest the morbid growth, and ultimately cause its absorption by ligating the femoral artery; but, although his patients, three in number, were, from all accounts, much benefited, it is questionable whether, in any, a complete cure has been effected. In the summer of 1857, I was present at the Philadelphia Hospital, when Dr. Campbell, then surgeon-in-chief, performed an operation of this kind upon a negro, aged about fifty, who had long been afflicted with this complaint in one of his legs; but the result was not at all encouraging. I saw the man occasionally afterwards for many months, and during my last visit to him, more than a year after the operation, the limb had not undergone any material change, either in volume or consistence. Indeed, such a procedure could hardly be expected to eventuate favorably, when we take into consideration the excessive disorganization of the parts and the astonishing enlargement of the branches of the femoral artery. The operation might, if performed early in the disease, and if conjoined with the use of sorbefacients and the bandage, be worthy of further trial; but I should certainly not feel inclined to recommend its indiscriminate employment.

When the diseased mass is very large, greatly incommoding by its weight and bulk, and entirely unamenable to treatment, the only resource is removal with the knife. If it occupy a limb, amputation will be both a safe and a facile procedure, but if it involve the scrotum, penis, or pudendum, excision may prove not only extremely difficult, but exceedingly perilous, life being endangered, in the first instance, by shock and hemorrhage, and afterwards by pyemia and exhausting suppuration.

7. KELOID TUMORS.

The keloid tumor, so called from its fancied resemblance to a crab, is an affection of the skin, first accurately described by Alibert, in his treatise on cutaneous diseases, in 1810. It is characterized by the existence of hard, semi-elastic, prominent excrescences, of a cylindrical or rounded form, more or less discolored, and the seat of an unpleasant itching sensation. Processes, roots, or branches usually extend from it into the neighboring parts, the whole looking very much like the cicatrice of a burn.

The disease is generally described as being extremely infrequent; but judging from my own experience I am far from thinking that this is the fact. I have notes of at least thirty cases, and many more have come under my observation of which I have neglected to keep a record. It occurs in all classes of society, in both sexes, in nearly all parts of the body, and at almost all periods of life. The youngest case of it that has been under my charge was that of a little girl three years and a half old; on the other hand, I have repeatedly seen it after the age of sixty. A number of my patients were negroes; but whether they are more subject to the disease than whites I am not prepared to affirm, although this is highly probable.

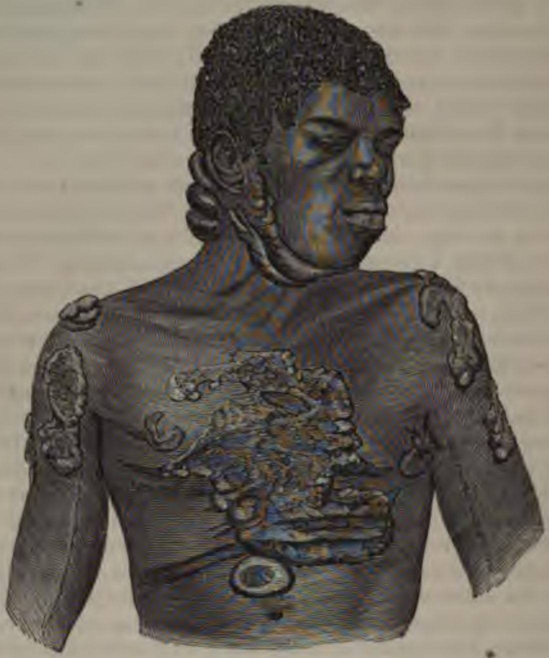
The exciting *causes* of keloid are not always the same. In some cases, though these constitute a marked minority, it arises spontaneously, and is then very liable to show itself in various parts of the body, as if the individual was laboring under a real keloid diathesis. Of this form of the affection I have seen two remarkable examples. In general, keloid succeeds to some local injury, sometimes of a severe, but more commonly of a trivial character, as, for instance, a scratch, puncture, or abrasion. In four of my cases it supervened, respectively, upon the operation of cupping, the application of a blister, the contact of nitric acid, and the cicatrices left by small-pox. In another instance it broke out upon a vaccine scar. In a young lady of seventeen, it was produced by the application of caustic potassa, employed for destroying an enlarged lymphatic ganglion of the neck. In several cases I have known it to follow the use of the knife in the extirpation of tumors. Thus, in an elderly lady from whom I removed the right mammary gland, two years and a half ago, two well-marked keloid growths came on, soon after the operation, at the site of two small incisions made to ease one of the flaps with a view to more accurate approximation; and the occurrence of the disease after the ablation of keloid tumors both at the line of union of the edges of the wound and at the parts transfixed by the pins used in introducing the twisted suture, is familiar to every one who has seen much of this affection. But the most common causes of keloid, so far as my observation and reading extend, are burns and scalds; the great majority of the cases that have come under my notice having been produced in this way.

The period which intervenes between the occurrence of the exciting cause and the actual development of the disease is altogether uncertain; in many cases it is quite short, not exceeding a few weeks, or, at farthest, a few months; on the other hand, however, the time is occasionally much longer.

In several of my cases, the tumors had acquired a large bulk in the space of a single year. Once fairly commenced, the disease generally proceeds with marked rapidity, especially when it is the result of some traumatic cause; the same is also true, at least in some instances, when it arises spontaneously. Thus, in an instance recently under my observation, an immense number of these excrescences appeared spontaneously upon different parts of the body within a few months after the first manifestation of the morbid action.

The peculiar *external characters* of keloid will be readily understood from the annexed drawing, fig. 190, taken from a colored man upwards of fifty years of age, whose body was literally covered with morbid growths of this kind. They were particularly numerous on the neck and trunk, both in front and behind, and also on the shoulders and arms, while the forearms, hands, and lower extremities were entirely exempt from them. In size they ranged from that of a small Lima bean up to that of a sausage, from six to eight inches in length. They were of all shapes; some round or cylindrical, some elongated and flattened, some angular, some crucial, some crab-like or full of processes, roots, or prongs; in short, nature seemed to have exhausted her ingenuity in devising figures for their representation. The surface of nearly all was rough, wrinkled, or puckered. Most of them projected from a line and a half to an inch and a quarter above the surrounding level; some were isolated, others ran into each other, thereby adding still farther to their grotesque appearance. Their consistence varied; most of them were remarkably hard and firm, feeling very much like a mass of fibro-cartilage, with a slight degree of the elasticity inherent in that tissue. In regard to their color, some resembled the natural skin, but the great majority of them

Fig. 190.



Keloid tumors.

were several shades lighter. The intervening integument was sound up to the very borders of the keloid tumors, which were all distinctly circumscribed, and slightly movable, allowing themselves to be raised up with the thumb and index finger; only a few seemed to be completely tied down.

This remarkable case had commenced early in life, but had for years past been almost stationary. The man was well conditioned when I saw him, and his general health had all along been excellent; the only annoyance which he experienced was an itching or stinging sensation in some of the tumors, which, although at times very severe, especially when he labored under constipation or accidental overheating of the body, left him sufficient comfort for sleep and other enjoyment.

Through the kindness of Dr. Hazard, of this city, I had an opportunity, last summer, of seeing another very interesting case of spontaneous, universal keloid disease, in the person of a young gentleman, aged 18 years, a native of Cuba. Up to twelve months previously, when it first began to show itself, he had always enjoyed excellent health, and, so far as he knew, he was perfectly free from hereditary taint of every description. The tumors were, for the most part, of a rounded or oval shape, not very hard to the touch, movable, vascular, and of a dusky reddish hue. In a few places they existed as distinct ridges, from a line to an inch in width, projecting prominently beyond the level of the surrounding surface. The hands and feet were covered with them, particularly the joints of the fingers and toes; they were also found on the legs, knees, buttocks, right arm, and elbow. They were free from pain, and quite tolerant of manipulation. The general health was somewhat impaired, the youth looking dyspeptic, and laboring under partial paralysis of the left superior extremity.

In white persons the keloid tumor is generally a few shades redder than the adjoining skin; occasionally, indeed, it has a very fiery appearance, and is pervaded by numerous, delicate, superficial vessels, in a state of habitual congestion.

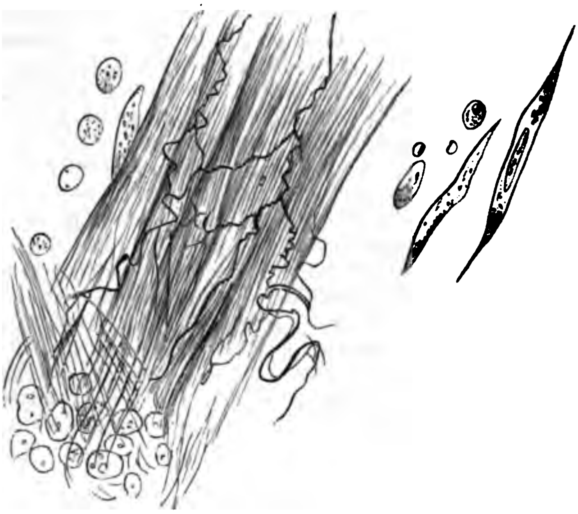
The *site* of the keloid tumor presents nothing of a definite character. When traumatic, it may occur in any part of the body, and the same thing, as we have already seen, may happen in the idiopathic form. It is generally supposed that it is particularly prone to appear on the chest, but, judging from my own observation, I should be inclined to doubt it.

Pathologists have made a distinction between keloid tumors by separating them into two *varieties*, the true and the spurious. The former, it is alleged, arise spontaneously, whereas the latter are always caused by some local injury, such as that already referred to. From my knowledge, however, of this disease, I am satisfied that such a division is altogether arbitrary, and, consequently, without any foundation in nature; the structure in both of the so-called varieties being perfectly identical.

Keloid, although a troublesome, is not a *dangerous* disease, inasmuch as it never degenerates into malignancy. Of all the cases that have come under my notice, not one has exhibited such a tendency. When excised, however, it nearly always returns, and that in a very short time, rising with increased activity, like a phœnix from its ashes; so that the second state is literally much worse than the first. In some cases, the tumors remain completely stationary for a long time; in others, on the contrary, they gradually advance until they have acquired a considerable bulk, when they usually become passive, and so continue for many years. Occasionally, in consequence apparently of prolonged pressure or local irritation, they take on ulcerative action, but such an occurrence is, according to my observation, very unusual.

In regard to their *structure*, keloid formations belong to the class of fibroplastic growths, described in the chapter on tumors. The fibres intersect each other in every possible direction, intercepting cells or spaces occupied by plastic matter, of a softer nature. A section presents, to the naked eye, a whitish, homogeneous aspect, or, if the mass be very old, very much the appearance of an unripe pear or turnip. It creaks slightly under the knife, and is of a dense, firm consistence, with very little elasticity. Hardly any vessels are perceptible in its interior, but the surface of the growth is usually, as already stated, quite vascular, the vessels passing over it in distinct lines, more or less tortuous and varicose in their arrangement. The minute structure of keloid is well seen in fig. 191, drawn from one of my specimens by Dr. DaCosta.

Fig. 191.



Microscopical characters of keloid.

The *treatment* of keloid is altogether unsatisfactory. So far as I know, there is no remedy which exercises the slightest influence in arresting its progress or promoting its removal. Sorbefacients and alterants of every description, in every form of combination, and in every variety of dose, have been employed, and yet I am not aware of a solitary instance in which their exhibition, however protracted, has been followed by a cure, or even by a tendency towards such a result. The different preparations of iodine, arsenic, chloride of barium, hydrochlorate of ammonia, and other kindred articles, so serviceable in some other morbid growths, have all signally failed in effecting any beneficial changes in this. The excessive itching, burning, or stinging, which is a source of such annoyance when the tumors are large or numerous, is best relieved, according to my experience, by a proper regulation of the diet, an occasional active purgative, the exhibition of the antimonial and saline mixture with Fowler's solution of arsenic, and the frequent use of the tepid bath, either simple, or medicated with soda, potassa, common salt, or bran. Anointing the tumors occasionally with oil or mild pomatum will also prove serviceable. Everything like pressure or local irritation must be carefully guarded against. If ulceration arise, none but the most soothing remedies should be employed.

As to *excision*, my experience is decidedly opposed to it. In the many cases in which I have tried it, signal failure has been the result, the disease always returning at the site of the cicatrice within a short time after. It is only when the tumors act obstructingly, as when they impede the opening of a natural outlet, or become a source of great disfigurement, that interference should be considered as warrantable. In some cases relief might possibly be afforded by a plastic operation, but on this point I am not able to say anything from personal experience.

8. EILOID.

The eiloid tumor is extremely uncommon, only a few cases having hitherto been met with. It was first described by Dr. John C. Warren, who gave it the present name in consideration of its peculiar coil-like disposition. In its earlier stages it presents the appearance of a small elevation, similar to that occasioned by a burn, which goes on gradually increasing, without pain, heat, redness, or ulceration, until it acquires a large bulk, and sensibly affects the general health. The rolls, in the case of the Boston surgeon, lay in close contact with each other, each being about four inches in length, the whole together looking very much like a triple coil of inflated intestine. The growth seemed to have begun on the right side of the neck by a narrow base. The patient was a negress, about fifteen years of age, whose health had not been good for some time past. The tumor, although removed along with a portion of sound skin, soon returned. When the girl was seen eighteen months afterwards, it occupied the same site, but was not as large as the original one. Being again extirpated, it rapidly reappeared, and soon proved fatal, the patient dying dropsical. Dissection of the body revealed important disease of the liver, water in the splanchnic cavities, and great enlargement of the lymphatic ganglions of the abdomen.

Of the anatomy of eiloid nothing is known. It probably takes its rise in the substance of the dermis, but how, or in what particular part, has not been determined. It is to be regretted that Dr. Warren has failed to inform us whether the secondary growth had the same coil-like appearance as the primary one. The only remedy, of course, for this disease, is early and efficient extirpation, with proper attention afterwards to the general health.

9. LEPOID.

The lepoid formation is most generally observed upon the face, nose, and forehead of elderly persons, usually males, of a delicate florid complexion, with a habitual tendency to congestion of the capillary vessels, light eyes, and light, brown, or reddish hair. Although occasionally single, I have more commonly found it to be multiple. In some instances, indeed, quite a number of lepoid spots are observed, scattered about in different directions, with intermediate healthy skin. It generally makes its appearance in the form of a small, circumscribed speck, not larger, perhaps, than a mustard seed, and of a dirty, grayish color, which becomes covered with a very rough, brownish crust or scale, resembling the bark of a tree, whence its name. This, falling off, is soon succeeded by another, of the same complexion, form, and consistence. Thus the disease is often kept up for many successive years. At last, however, ulceration sets in, and the dermis exhibits a red, glossy surface, spicular, pitted, or granular, and throwing out a thin, ill-elaborated pus. The skin, upon inspection, is found to be almost of a gristly hardness, its internal surface being studded with numerous little, whitish, rounded bodies, connected together by a dense, grayish substance. The progress of the disease is attended with hardly any pain; but the patient is generally very much annoyed by itching, leading to an irresistible desire to scratch, which always aggravates it.

The nature of lepoid is undetermined. Without being able to speak positively, I am strongly inclined to believe that it is merely a variety of lupus or epithelioma; a supposition deriving plausibility from the circumstance that, although generally disposed to remain long stationary, or to make but little progress, it often ultimately takes on malignant action; pursuing then very much the same course as the milder forms of lupus.

The best remedy for this disease is non-interference. The rough, bark-like scale may occasionally be softened with a little very dilute citrine ointment, or covered with a mixture of two parts of collodion and one of castor oil, to serve as a defence from the air. All irritating applications must be refrained from. If the disease is inclined to spread, the tissues may be destroyed with the Vienna paste, or removed with the knife; but in general it will be safest to eschew all operative interference, as likely to aggravate the case by an early recurrence of the formation, and its more rapid tendency to malignancy.

10. LUPUS.

Under the term lupus are comprehended two varieties of disease, the chief peculiarity of which is a tendency to destructive ulceration of the skin and areolar tissue, or of these and the more deep-seated structures. In point of fact the two affections are identical, the only difference between them being that the one is milder than the other, more tardy in its progress, and less disposed to spread, its ravages being generally limited to the cutaneous textures, or to the parts in which it is originally located. The former of these affections is called the non-exedent, stationary, or serpiginous ulcer; the latter the exedent, eating, or corroding ulcer. It is also known as the cancroid or voracious ulcer. The older surgeons described it under the appellation of *noli me tangere*, in reference to the exquisite sensibility by which it is so often characterized. The term lupus, signifying wolf, is suggestive of the destructive tendency of the affection.

Of the *causes* of lupus, in both of its forms, we have no definite knowledge. In general, it comes on spontaneously, or without any assignable reason, and soon exhibits its peculiar features. Occasionally its origin is apparently referable to some local injury, as a scratch, abrasion, or contusion, or to the irritation of some warty growth. It is commonly supposed that a scrofulous state of the constitution predisposes to its occurrence, and this is probably true, although in a much less degree than has been imagined. My own experience certainly does not warrant the conclusion that the origin of the disease has, in general, any such relation; in most of the cases that have come under my observation, the patients seemed to be peculiarly free from strumous taint, both as it respected the actual state of their own system, and everything like hereditary transmission. Persons of a delicate, ruddy complexion, with light hair, blue eyes, and an unusually active capillary circulation, are most prone to the disease, not only as it regards its frequency, but also the rapidity of its progress and the extent of its ravages. How far a syphilitic taint of the constitution may act as a predisposing cause of lupus is a point that has not been ascertained; unfortunately, it is seldom in the power of the practitioner to obtain a sufficiently accurate account of his cases to enable him to trace, in a satisfactory manner, their various relations.

Lupus may occur in any part of the body, but it will most commonly be found to manifest a peculiar predilection for the nose, cheeks, and eyelids, especially the lower. It is observed in both sexes, and rarely shows itself until after the age of forty. When it attacks the face, it sometimes breaks out simultaneously, or nearly so, at several points. The ulcers, in both varieties of the affection, are usually of an intractable nature, or if, as occasionally happens, they heal at one place, they are sure to spread at another. Their secretions are of an ichorous nature, and their surface is covered by a brownish, characteristic scab. If reparation take place, the new skin is always very hard, white, irregular, and prone to take on disease from the slightest causes.

1. The *non-exedent lupus*, often described as the serpiginous ulcer of the face, generally begins either as a small, hard, white, shining tubercle, or as a fissure, crack, or excoriation, with indurated edges, and a thin, brownish incrustation. In either case, it soon exhibits its characteristic tendency to spread, not in depth, but circumferentially, for it rarely, at least in its earlier stages, penetrates beyond the substance of the true skin, or even far into it. In fact, it is essentially a superficial ulcer, passing generally from one point to another, but seldom involving the deeper structures, except, perhaps, when it appears on the ala of the nose, where it occasionally evinces a highly erosive disposition. When it affects the eyelids, it may, in time, extend to the fibres of the orbicular muscle, and even to the tarsal cartilage, but in general it remains limited for years to the skin, or skin and areolar tissue. The parts around the ulcer are hard, puckered, tender, and usually somewhat reddish, although very often they retain their normal color. The ulcer is the seat of occasional, darting, stinging, or shooting pain, and of more or less itching, generally much more disagreeable than the pain itself. When the scab, which is usually very thin, and of a brownish, or blackish color, drops off, it is speedily succeeded by another of a similar kind. When the surface is thus exposed, it is occasionally found to be covered by very red, vascular, sensitive granulations, smeared over with thick, yellowish, viscid pus, and disposed to bleed on the slightest touch. The edges of the ulcer are usually steep, jagged, and slightly everted. As the sore spreads in one direction, it often heals in another, leaving a whitish, leucoid, or milky scar, strikingly contrasting with the surrounding parts.

The non-exedent form of lupus is said to be most common in young scrofulous females, but, if this be the fact, my experience has failed to afford me any evidence of it. In most of the cases that have fallen under my observation, and they have been very numerous, it appeared after middle life, in both sexes, with a complexion that was either very florid at the time, or had been so shortly before the attack. My opinion is that writers often confound this affection with the effects of a syphilitic taint of the system, exhibiting itself in the form of one or more superficial, foul, obstinate ulcers, which, when their nature is properly understood, may always be made to disappear promptly under the use of iodide of potassium and bichloride of mercury.

In the *treatment* of this variety of lupus, none but the mildest and most soothing applications should be employed. The one from which I have derived most benefit is the dilute tincture of iodine, which, while it changes the action of the secernent vessels, promotes the removal of effused fluids, and serves as a protective against atmospheric and other injurious impressions. As long as the scab remains on the surface of the ulcer, it should not be disturbed; otherwise it may be covered with a piece of lint, spread with a small quantity of the ointment of the nitrate of mercury, largely diluted with simple cerate. Occasionally a little powdered opium forms a valuable addition. Brushing over the part once every three or four days with a mixture of collodion and glycerine often answers a good purpose. When the ulcer is foul, and has a disposition to spread, it should be touched once or twice, lightly but effectually, with the dilute acid nitrate of mercury. All severe applications must be avoided, as they generally do immense harm.

Along with these topical remedies, special attention must be paid to the state of the general health, which is often not a little disordered. The diet should be light, simple, unirritant, and chiefly, if not exclusively, of a vegetable character, the drinks consisting of water, milk, or weak tea; the bowels and secretions should be regulated with blue mass and ipecacuanha, or blue mass and colocynth; and if signs of debility exist, as denoted by the state of the countenance, pulse, and strength, tonics should be resorted to, in combination with alterants, of which the best are quinine and iodide of iron, in combination with a minute quantity of bichloride of mercury and arsenious acid. Of late, very favorable mention has been made of the use of the chloride of arsenic in the treatment of this affection, in doses varying from eight to fifteen drops thrice a day, and a number of cases illustrative of its beneficial effects have appeared in the medical journals. Of its efficacy, however, I can say nothing from personal experience. When the vital forces are much impaired, cod-liver oil and milk punch must be pressed into the service.

2. The other variety of lupus, the *exedent*, corroding, or devouring lupus, of authors, belongs unmistakably to the class of affections described by modern pathologists under the name of epithelioma, or cancroid disease. It is a genuine cancerous development, generally beginning in the form of a hard tubercle, crack, or warty excrescence, and rapidly extending in different directions, both in circumference and depth, until it has occasioned the most frightful ravages, and the most dreadful and disgusting deformity. Thus, it often consumes the whole of the nose, one cheek, the entire lip, the chin, or perhaps the orbit of the eye, and the forehead, the ball of the eye being completely severed from its connections and dropping down into the frightful chasm below. To witness some of these cases is a truly pitiful and shocking sight. The progress of the disease is often remarkably rapid, great mischief being sometimes done in a few months; at other times its march is more slow, or the malady, after having evinced a most destructive tendency, may suddenly stop, with all the appearances of a complete cessation of hostilities. A case has been reported to me where the morbid action, after having destroyed the greater portion of one cheek with the corresponding antrum, has remained in a state of abeyance for the last eight years, although it had been steadily pursuing its course for upwards of fifteen.

The ulcer in this variety of lupus has an excavated appearance, as if it had been punched out of the parts on which it rests; its edges, however, are generally somewhat everted, or everted at one place and slightly overhanging at another, ragged, and often as if worm-eaten; the bottom is foul and covered with unhealthy granulations, or granulations and aplastic lymph; the discharge is ichorous and irritating; and the surface around is indurated, tender, and more or less discolored and œdematous. The pain is generally severe, being of a sharp, biting, darting, or shooting character, and liable to temporary exacerbations from exposure, irregularities of diet, and atmospheric vicissitudes. The general health, at first perhaps entirely sound, becomes seriously affected during the progress of the disease; the appetite and sleep are impaired; the strength declines; marasmus gradually ensues; and the patient, worn out by suffering, finally dies completely exhausted.

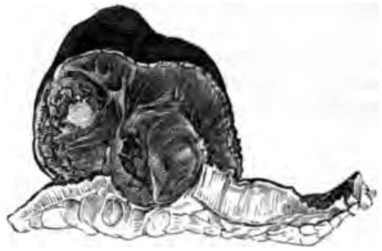
The great object in the *treatment* of the corroding form of lupus is to arrest the morbid action, either with the knife, or some suitable escharotic, as the acid nitrate of mercury, or the Vienna paste. In regard to the first of these measures, I must confess I have no great confidence in its efficacy as a means of preventing a recurrence of the disease, since it does not appear to be capable of exerting upon the capillaries in the neighborhood of the affected parts that alterant influence which is necessary to cause a permanent suspension of the specific action upon which the malady originally depended. In most of the cases in which I have employed the knife, the result has been anything but flattering, notwithstanding the most thorough excision and the most careful attention in regard to the after treatment. Indeed, I have often been struck with the apparent avidity, so to speak, with which the disease returns. My opinion, therefore, is that excision, as a general rule, should give way to escharotics, either such as have been just alluded to, or, what I believe is preferable, in nearly all cases, the actual cautery. The hot iron not only effectually destroys the diseased tissues, but it seems to create a wide spread salutary influence among the surrounding parts, eminently unfavorable to repullulation. Notwithstanding, however, all the care and precaution that can be employed both to get rid of the disease and to oppose its return, it must be confessed that our efforts are generally, in the end, unavailing, the malady usually coming back, and ultimately terminating fatally.

As long as the disease is stationary, it will be best, as a general rule, not to interfere with it in any manner; the scab, if there be any, should be let alone, or, if the surface be exposed, it should be treated with the most soothing and gentle means.

The general health must, in this as in the more simple variety, receive, throughout, proper attention; alterants and tonics will often afford essential service; and the strictest vigilance should be exercised in regard to the diet, bowels, and secretions. Arsenic, bichloride of mercury, and iodide of iron are particularly deserving of trial as constitutional remedies.

11. MELANOSIS.

Fig. 192.



Nodule of black cancer in the true skin.

Melanosis of the skin, fig. 192, is very uncommon, and probably never occurs as a primary disease, being apparently always propagated from the subcutaneous cellular substance, or from some lymphatic ganglion. It nearly always co-exists with melanosis in other parts of the body, and is, therefore, merely an evidence of a general taint of the system. In a case that was under my observation, some years ago, in a man, aged fifty-eight, it involved nearly all the principal organs, and of course finally proved fatal. In another instance which occurred in this city, while I was a pupil of the late Dr. George McClellan, an immense number of melanotic tumors existed in the skin and cellular tissue of the abdomen, varying from the volume of a small pea up to that of a mass the size of a large almond; they were of a firm, fibro-cartilaginous consistence, slightly movable, exquisitely painful, and of a bluish-black color. The remedy, in this case, was excision, a few of the larger tumors being removed at a time; the operation was repeated every ten or twelve days, for several months, by which time, but little progress being made towards a cure, the patient became tired, and positively declined further interference. He finally died completely exhausted by his disease.

When melanosis is confined to the integuments, and occurs as a circumscribed tumor, the proper remedy is early and free excision; but under opposite circumstances, or, when it co-exists in other parts, or is extensively diffused through the cutaneous and areolar tissues, all interference of the kind should be avoided, as likely to accelerate the fatal crisis.

12. SCIRRHUS.

Scirrhus of the cutaneous tissue is also exceedingly uncommon; it is, however, occasionally met with in various parts of the body, particularly the face, forearms, and hands. It generally begins in the form of a whitish, milky, or leucoid spot, commonly a little elevated above the surrounding level, but now and then apparently somewhat depressed, of a dense, firm consistence, more or less rough, and completely inlaid in the substance of the skin. Large vessels frequently extend across the affected parts, the redness contrasting strikingly with the whiteness of the intervening surface. Movable at first, the tumor gradually contracts adhesions, and, in time, involves the subcutaneous cellular substance. If a section be made, it will be found to be traversed by white lines, and to yield, on pressure, a small quantity of lactescent fluid.

Although the progress of this affection is usually slow, its tendency is ultimately to disintegration and decay, the resulting ulcer having an irregular, jagged appearance, with everted edges, and a foul bottom, the discharge being of a sanious or ichorous nature. More or less pain, of a sharp, lancinating character, generally attends. As the morbid action proceeds, new leucoid spots are often superadded to those already existing; the health gradually gives way, and the patient finally dies exhausted, though commonly not until carcinomatous disease has developed itself in some of the internal organs, particularly the lungs, pleura, and liver. Occasionally the affected parts assume a true encephaloid character, and in this way a tumor of considerable size may ultimately be formed, very tender, vascular, and subject to frequent hemorrhages. Finally, the scirrhous matter sometimes exists as an infiltration, although such an occurrence is very infrequent.

Secondary scirrhus of the integuments is by no means uncommon; it is most frequently seen in carcinoma of the mammary gland and lymphatic ganglions, and generally presents itself in the form of small, hard, shot-like tubercles, firmly and immovably fixed in the substance of the skin. The number of these little bodies is sometimes very great; they are usually quite painful, seldom attain much bulk, and do not often ulcerate, the patient nearly always dying of the primary disease before this event has had time to take place.

The ultimate character of these secondary formations is not well understood; in most cases, especially when of long standing, and of large size, they contain encephaloid matter and true cancer juice. Melanotic substance is sometimes interspersed through them.

Scirrhus of the integuments presents the same unrelenting character as this disease in other parts of the body; extirpation, the only resource in the early stage of the malady, holds out no prospect of permanent relief, and hence all that can generally be done is to palliate the patient's suffering.

SECT. VIII.—INSECTS IN THE SKIN AND CELLULAR TISSUE.

The skin and cellular tissue are liable to be infested by certain insects, which although not poisonous, are capable of inducing serious suffering, especially in persons of a nervous, irritable temperament. I refer more particularly to the chigoe and the Guinea worm.

The *chigoe*, which is very common both in this country, South America, and the West Indies, is a little insect, scarcely half the size of the smallest pin head, which penetrates the skin of the hands and feet, as well as of other exposed parts of the body, for the purpose of sustenance and hatching. It is a species of flea, with a rostrum as long as the body, of a pale-brownish, semi-transparent appearance, with legs of a light lead color, which often deposits its eggs in immense numbers. The first effect is an itching sensation, which is soon followed by heat, redness, and swelling, and, ultimately, by an ugly, irritable, spreading ulcer. If the part, when it has attained this stage, be carefully examined, it will be found to contain a cyst, about the size of a pea, and of a bluish color, in which the ova live and multiply with astonishing rapidity. When a number of chigoes penetrate the skin together, the suffering produced by them may be so great as to cause violent constitutional disturbance and even death.

The *treatment* consists in picking out the insect and its eggs with a fine needle, care being taken not to rupture the cyst, otherwise the young brood may produce further mischief. Clearance having been effected, the part is well washed with salt water, tobacco juice, or spirits of turpentine, and thoroughly painted with dilute tincture of iodine. The female slaves in the West Indies are said to extract these insects with great dexterity.

The Guinea worm, or little dragon, technically called *filaria medinensis*, also buries itself in the body. It is chiefly met with in hot countries, particularly in Egypt, Arabia, Persia, Abyssinia, and Guinea, the inhabitants of which are often sorely afflicted by it. Of a white color, and of a filiform shape, it has an orbicular mouth, and a slightly pointed tail, its usual length being from five to ten inches, and its thickness that of a small violin string. Its ordinary abode is the subcutaneous cellular tissue of the feet and legs, though it is also found in other parts of the body, as the face, neck, scrotum, hands and arms. It is commonly coiled up circularly, and is inclosed by a distinct cyst, which thus separates it from the surrounding parts. The animal enters the skin when quite young, and gradually increases in size, exciting intolerable itching, inflammation, swelling and suppuration, often attended with fever, and sometimes followed by gangrene. The precise situation of the worm is generally indicated by a sort of boil, or a hard, ridge-like elevation. When ulceration sets in, the head of the creature usually protrudes at the opening, thus confirming the diagnosis of the case.

In the *treatment* of this affection, the proper plan is not to allow the patient to be tormented by the employment of inefficient remedies, but to cut down at once upon the part, and extract the intruder. It is worse than useless to waste time in the application of leeches, liniments, and embrocations, which, so long as the cause of irritation lies buried under the skin, can produce none but the most transient effect. If the tumor is already open, and the head of the animal is protruding, extrusion may be promoted by gentle tractions.

CHAPTER II.

DISEASES AND INJURIES OF THE MUSCLES, TENDONS, BURSES, AND APONEUROSES.

SECT. I.—MUSCLES.

THE muscles are liable to wounds and lacerations, inflammation, atrophy, hypertrophy, and different kinds of transformations, especially the fatty form, which occasionally exists in a very high degree, and over a considerable extent of the body. They are also subject to some of the carcinomatous formations, and to the development of hydatids and serous cysts.

1. *Wounds.*—When a muscle is divided by a sharp instrument, or accidentally ruptured, its fibres immediately retract so as to drag the edges of the wound more or less widely asunder. The extent to which this separation may be carried varies, in general, according to the length and thickness of the muscle, from a few lines to as many inches. In transverse fractures of the patella, the action of the straight muscle of the thigh often draws the superior fragment from three and a half to four inches away from the inferior; and it is reasonable to conclude that fully as extensive a gap would be produced between the ends of this muscle if it were cut in two, or torn asunder. In rupture of the straight muscle of the abdomen, the edges of the subcutaneous wound have repeatedly been found to be separated from an inch and a half to two inches. In the operation for the cure of strabismus, the retraction of the posterior extremity of the divided muscle is seldom less than from four to six lines, and often even considerably more.

The above facts are highly interesting in a practical point of view, inasmuch as they point out the propriety of adopting prompt and energetic measures for effecting and maintaining apposition of the ends of the divided muscle; for observation has shown that the more accurate this is the more speedy and perfect will be the cure. If the edges are brought fully and intimately together, the union will necessarily require but a small quantity of plastic matter for its early and complete consolidation. If, on the other hand, the gap amounts to several inches, either no union will occur, or it will be effected through the intervention of a large quantity of cellulo-fibrous tissue, possessing none of the properties of muscular fibre. Hence the affected structures must always remain proportionably weak and disabled. But this is not the only inconvenience that follows such an accident; in wounds of the abdominal muscles, for example, the gap is sure to give rise to hernia, and it is easy to see that a deficiency of this kind elsewhere would hardly be productive of less serious effects.

2. *Laceration.*—Rupture of the muscles is often produced by very trifling causes, the most common of which are leaping, or jumping across ditches or over fences, lifting heavy weights, or falls from a considerable height, in which the person makes a powerful effort to ward off injury. Cases are upon record of women having lacerated the abdominal muscles during parturition. Injuries of this kind are most likely to happen, other things being equal, when a muscle has undergone the fatty degeneration, which, by rendering its fibres

soft and lacerable, acts as a powerful predisposing cause of rupture. Long continued inactivity of a muscle followed by sudden and violent contraction may be mentioned as another predisposing cause of the accident.

The muscles which are most liable to rupture are the straight muscles of the abdomen, the psoas, deltoid, the two-headed flexor of the arm, the straight femoral, and gastrocnemius.

The place where the rupture usually occurs is near the junction of the fleshy fibres with their tendons; but occasionally a muscle may give way at its middle, or, in fact, at almost any portion of its extent. In twenty-one cases of this affection analyzed by Sédillot, the rupture, in thirteen, took place at the insertion of the fleshy fibres into their tendons, while in the remainder the lesion was seated in the body of the muscle itself. The laceration is sometimes limited to a few fibres; at other times it involves the entire thickness of a muscle, or of a muscle and its aponeurotic envelop. Finally, cases occur in which a number of muscles are ruptured.

The *symptoms* attendant upon this lesion are not always well marked, especially when the affected muscle is deep seated. In general, it may be assumed that the accident has occurred, if, at the moment of some violent bodily exertion, as in leaping a ditch or fence, the individual has heard a distinct noise or snap, like the crack of a whip, feels severe pain in some particular spot, and either falls down, or has but an imperfect use of himself. Upon examining the suffering part, a vacuity will probably be noticed at one point, and an unusual prominence at another, followed by more or less discoloration and tenderness under manipulation. Occasionally the accident is attended with a rather copious hemorrhage, caused by the rupture of an artery of considerable size, as, for instance, the epigastric in laceration of the straight muscle of the abdomen. The pain which follows the injury is often very sharp, and rarely entirely disappears until after the primary effects of the lesion have measurably passed off.

Temporary lameness and inability to move about for some time are, in general, the most serious consequences to be apprehended from this accident, provided it is properly managed immediately after its occurrence. In most cases, a considerable period must necessarily elapse before the reunion of the torn structures will be sufficiently firm to justify their accustomed use. Occasionally violent symptoms have supervened upon the accident; and an instance has been reported of a young man who died from rupture of the psoas muscle, death having been preceded by severe inflammation and infiltration of pus.

The *treatment* of this lesion cannot be the same in all cases, or under all circumstances. Whenever it is practicable, from the superficial situation of the affected muscle, its ends, whether they have been cut or ruptured, should be freely exposed, and then carefully approximated by a sufficient number of stitches to hold them in contact until firm union has been established. For this purpose the threads should be carried nearly through the entire thickness of the muscle, the object being thorough apposition both of the superficial and deep portions of the wound. In case the muscle has been ruptured, the edges of the wound may be so ragged as to require some retrenching before placing them in contact, just as in a lacerated wound of the integuments. If the precaution of stitching the parts be neglected, the results above adverted to will be inevitable, and it is, therefore, impossible to insist too strongly upon the importance of attention to this rule, which is so much neglected by surgeons.

The parts being properly approximated are next placed in an easy, elevated, and relaxed position, splints and bandages being employed for this purpose, if necessary; they are then treated upon general antiphlogistic principles. If the ruptured muscle be deep-seated, our chief reliance must be upon rest and relaxation, aided by soothing and astringent applications, along with suitable internal remedies, to moderate the resulting inflammation. In lacerations of the muscles of the extremities, important advantage may always be obtained from the use of two rollers, applied in opposite directions, as the ends of the wound may thus not only be more effectually approximated, but the contraction of the fleshy fibres more easily controlled, than in any other manner.

3. *Inflammation.*—Inflammation of the muscles may present itself in two varieties of form, the acute and chronic; both, however, are uncommon, and are chiefly observed as consequences of external injury, as blows, wounds, or contusions, such as we meet with in fractures and dislocations; or as effects of gout and rheumatism. The sheaths of the muscles very frequently, if not generally, participate in the morbid action. When the inflammation is at all severe, considerable effusion of serum and lymph may take place, but it is seldom that the disease runs into suppuration, much less mortification. The latter termination is chiefly met with in erysipelas and carbuncle, in old worn-out subjects, and in persons of different descriptions after violent external injury. It is easily recognized by the dark greenish color of the fleshy fibres, by their softness and lacerability, and by their excessively fetid odor. The parts are detached in ragged shreds, bathed in a thin, sanious, dirty, and offensive fluid.

Acute inflammation of the muscles is characterized by excessive pain, of a sharp, darting character, or by dull, heavy, aching sensations, accompanied with a feeling of soreness, and aggravated by the slightest motion and pressure. In some cases, as when the disease supervenes upon fractures or the amputation of a limb, it is attended by a remarkable twitching or jerking, occasionally amounting to real spasm, which only yields to large doses of anodynes, and hot, soothing applications.

Chronic myositis is not uncommon; like the acute variety, to which it generally succeeds, it is more frequently met with, surgically considered, as a secondary than as a primary affection. When long continued, it is very prone to give rise to fatty degeneration, softening, ulceration, and other changes, which it is often impossible to cure.

4. *Fatty Transformation.*—Fatty degeneration of the muscles is often, if not generally, a result of chronic inflammation, especially when conjoined for any considerable period with steady, persistent inactivity, or want of exercise. Whether inflammation, however, is always necessary to its formation is still a mooted question, although it is highly probable that it is. When thus affected the fleshy fibres assume a pale yellowish, whitish, or slightly reddish color, at the same time that they are unctuous to the touch, and so much softened as to yield under the most trivial force. On pressure, a clear, oily fluid comes out, which greases the finger, is highly inflammable, and is composed of elain, adipocire, and ordinary fat, in variable proportions. These substances are not deposited, as some have conjectured, between the fleshy fibres, but form actually a portion of their constituent principles; their proper tissue being found, when examined microscopically, to be filled with granules, partly interposed between their striæ, and partly replacing them.

The fatty transformation is most common, as well as most marked, in the muscles of the loins, hip, thigh, and leg of old persons affected with paralysis. It is likewise occasionally observed in the heart, and now and then in the muscles around unreduced luxations, large exostoses, and old, deep-seated ulcers. When the change is profound and extensive, it sometimes involves the corresponding tendons and aponeuroses, which, in consequence, lose their polished, satin-like lustre. So far as we know, this disease does not admit of cure.

5. *Ulceration.*—Ulceration of the muscles is an uncommon occurrence; it is chiefly noticed in phagedenic sores of the leg, extending successively through the integuments, cellular tissue, aponeuroses, and, finally, the muscles, which, however, generally resist its encroachments in a very remarkable degree. In some of these cases the fleshy fibres are in a complete state of fatty degeneration, of a whitish color, and so soft as to admit of being scraped away with the greatest facility. When the ulceration is slight, the restorative process usually proceeds kindly, and the breach is soon filled with healthy granulations. No special treatment is required in this disease, apart from the remedies ordinarily employed under such circumstances.

6. *Contraction.*—Another effect of inflammation of the muscles, or of the muscles and their fibrous envelops, is contraction of their fleshy fibres, leading to marked disorder of their functions, along, perhaps, with severe pain, and even to great deformity, as we so often see in wry neck, consequent upon inflammation of the sterno-cleido-mastoid and splenius muscles, and the muscles of the thigh from the effects of hip-joint disease. In many of these cases the disease is obviously of a gouty or rheumatic character, and, under these circumstances, it often occurs at a very early age, the immediate exciting cause being usually exposure to cold or cold and wet.

In the *treatment* of myositis attended with contraction of the affected muscles, the first object should be to ascertain, if possible, the nature of the exciting cause; as to whether it is the result of rheumatism, gout, scrofula, or syphilis, or of external injury, as a sprain, twist, blow, wound, or contusion; for upon the knowledge thus derived must necessarily depend the character of our remedies, and the chance or otherwise of a cure. I have usually received marked benefit in these cases from the use of the wine of colchicum in combination with a full dose of morphine at bedtime; aided by active purgatives and diaphoretics, especially the warm bath, a well-regulated diet, and the frequent application of Granville's lotion in union with laudanum and soap liniment, thoroughly rubbed upon the affected muscles. The muscular rigidity attendant upon a syphilitic state of the system is best treated with iodide of potassium, either alone, or conjoined with mercury.

In the more subacute or chronic cases of muscular contraction, great benefit may be expected from the use of the hot and cold douche, employed twice a day, and followed, first, by dry friction, then by the application of stimulating liniments, and, finally, thorough shampooing. Frequent motion is also generally of great service; to break up adhesions, and to promote the absorption of effused fluids, upon which the rigidity often mainly depends, as is observed in the shortened and rigid state of the limbs after severe fractures and dislocations.

7. *Atrophy.*—Atrophy of the muscles, of varying degrees, is occasionally observed; it may occur in any of the voluntary muscles, but is most common in those of the shoulder and hip, the deltoid suffering perhaps more frequently than any other individual member. It may depend upon different causes, but generally it is produced by inflammation, palsy, or defective circulation; indeed, whatever has a tendency to impair the function of innervation, retard or diminish the supply of blood, or induce permanent inactivity in a muscle, may be considered as so many causes of the affection. Hence it is found that the lesion is usually associated with paralysis, whether proceeding indirectly from disease of the cerebro-spinal axis, or directly from injury of the nerves distributed to the suffering structures. The muscles around luxated joints, especially those of the hip and shoulder, are frequently atrophied, either simply from the want of use, or, what is more probable, the conjoint influence of inflammation and inactivity. In coxalgia similar effects generally occur, the wasting usually involving all the muscles of the lower

extremity. The fact that gout and rheumatism are frequently productive of atrophy of the muscles is familiar to every practitioner.

The extent to which the wasting of the muscles may proceed is variable. When it exists in a high degree, they may be reduced to mere membranous bands, pale, flaccid, and almost devoid of irritability; in some rare instances their fleshy fibres are completely absorbed, a dense cellular substance being all that is left in their place; or, instead of this, they are found to be softened and transformed into fatty matter.

In the *treatment* of atrophy of the muscles the first object should be to ascertain, if possible, the nature of the exciting cause, by removing which the lesion sometimes rapidly disappears of its own accord, or, at all events, under very simple management. Atrophy dependent upon imperfect supply of blood is often irremediable, and the same is frequently the case when it is caused by gout and rheumatism, or when it is conjoined with the fatty degeneration. The treatment of atrophy dependent upon loss of innervation, constituting what is called wasting palsy, will receive special attention in the chapter on the diseases and injuries of the nerves, where its consideration properly belongs.

Whatever the cause of atrophy of the muscles may be, much may be done, after that cause has been removed, towards effecting restoration by the steady and persistent use of the hot and cold douche, stimulating embrocations, dry frictions, and regular, systematic exercise of the affected structures, educating them, so to speak, and thus gradually qualifying them for the resumption of their appropriate functions.

8. *Tumors.*—Various morbid growths occur in and among the muscles, the principal of which are the hydatic, cystic, melanotic, and encephaloid.

a. It is uncommon to meet with *hydatids* in the muscles; I have myself seen but one case of it. It occurred in 1853, at the surgical clinic of the University of Louisville, in a laboring man, aged twenty-five years, who accidentally discovered a swelling in the substance of the right deltoid muscle six months previously, when it was hardly as large as a hazelnut. At the time of my examination, it was of the volume of an almond with its shell, of a rounded, elongated shape, somewhat movable, and of a firm, fibrous consistence, with a slight degree of elasticity. Within the last few weeks the tumor had become somewhat painful, especially after exercise, and the pressure made in examining it was productive of considerable uneasiness. The skin over it was perfectly healthy. The patient was not aware of anything that could have produced the disease.

The diagnosis of the tumor could not, of course, be determined beforehand; what it resembled most, especially in point of consistence, was an enlarged lymphatic ganglion, but the rarity of such a disease in this situation invalidated this conclusion, and left me in complete doubt as to the true nature of the case. It was too deep-seated for a sebaceous tumor, and it possessed none of the external characters of a fibrous, fibro-plastic, or fatty one.

In performing excision, the knife was carried perpendicularly down over the tumor, in doing which, the point penetrated its interior, an occurrence which was instantly followed by the escape of a small quantity of thin pus, inducing me to think that the tumor, after all, was merely a diseased lymphatic ganglion. On continuing the dissection, however, I soon found that there was a distinct cyst, which, being collapsed, was separated with some difficulty from the fibres of the deltoid muscle, in which it was imbedded. The dissection being completed, a small body, fig. 193, was picked up on the floor, which, on inspection, proved to be a globular hydatid, not more than six lines in diameter, and furnished with a distinct sucker. The cyst was very soft and thin, smooth internally, and filamentous externally.

Fig. 193.

Hydatid.

b. Tumors of a *cystic* character are sometimes met with in and among the muscles. In a case of this kind, which I had an opportunity of seeing in 1856, with Dr. Da Costa, the growth, occupying the upper and outer portion of the thigh, had acquired nearly the volume of an adult head. The patient was a female, aged fifty-eight, and the disease had apparently resulted from a fall down a flight of stairs, in which she struck the limb severely, causing deep ecchymosis and great difficulty in walking. At the end of two months a swelling formed in the situation adverted to, which, gradually increasing, in the course of ten months acquired the size above mentioned, being at the same time the seat of severe darting pains, with considerable discoloration of the integuments. The tumor fluctuated indistinctly, but a puncture with the exploring needle gave vent merely to a few drops of fatty fluid. When removed by Dr. Brinton, it was found to be composed of a very thick, dense, fibrous cyst, filled with a sero-oleaginous fluid. The patient gradually recovered from the effects of the operation, but has been troubled ever since with pain in the limb and difficulty in walking.

c. Melanosis sometimes occurs in the muscles, either as an infiltration, or as a distinct tumor, with or without a cyst, of an irregularly spherical shape, firm in consistence, and from the volume of a pea up to that of a fœtal head. The morbid product, which generally coexists with similar formations in other parts of the body, is occasionally directly chargeable to external injury; but generally it takes place without any assignable cause.

d. Encephaloid, scirrhus, and colloid of the muscles are very uncommon, so much so, that few practitioners ever meet with them. They obey the same law here as when they occur in other parts of the body. In the interesting case of colloid described by Professor J. C. Warren, an immense number of tumors of this kind, varying in size from a pea to that of a small granule, hardly visible without the aid of a microscope, existed in the voluntary muscles, in different regions, especially in those of the thigh and leg.

The probability is that none of these heteroclite formations are developed in the muscular substance, properly so-called, but that they begin in the interfibrillar tissue, from which, as they increase in size, they gradually encroach upon the fleshy fibres, which they thus displace, alter, or destroy.

SECT. II.—TENDONS.

The tendons, like the muscles, are liable to wounds and lacerations, but, unlike them, they never suffer from malignant formations, excepting secondarily, and then only very rarely. Inflammation of these structures is also very infrequent.

1. *Wounds.*—Tendons, when divided subcutaneously, readily unite through the intervention of plastic matter, without the occurrence of any considerable degree of inflammation. Indeed, the idea is very common at the present day that such wounds are always repaired without inflammation, it being alleged that this process, instead of being necessary for this purpose, is a positive detriment. I cannot subscribe to such a doctrine. If its advocates mean that the inflammation is very slight, or not characterized by the ordinary phenomena, I perfectly agree with them; but if they wish to be understood as affirming that inflammation is entirely absent throughout, from the beginning to the close of the case, it is what I cannot believe, and what is certainly not true.

When a tendon, such, for example, as that of the heel, is cut across subcutaneously, the first thing that is noticed is the retraction of the divided ends, so as to leave a distinct gap between them, often amounting to from an inch and a half to two inches, according to the size of the cord and its previous tension, or the degree of force employed in stretching the parts with which it is connected. Inflammation, generally of a very slight form, next takes place, and, soon after this is set up, plastic matter is poured out, filling up the space between the two extremities of the tendon, which, at the same time, it serves to connect together. As the abnormal action subsides, nucleated cells form in the interior of the effused matter, and the process of organization thus begun steadily advancing, the new substance is gradually converted into cellulo-fibrous tissue, and this, in its turn, at length into tendinous, which, however, although well calculated to fulfil the purpose for which it is intended, is, like all new tissues, a very imperfect type of the original. The reproductive process generally advances very rapidly, so much so that the person soon acquires an excellent use of the affected parts. It is upon a knowledge of this property in tendon, when subcutaneously divided, to speedy reunion, that is founded the operation of tenotomy, one of the greatest improvements in modern surgery.

When a tendon is divided in an open wound, the two ends rarely reunite at all, owing mainly to two circumstances; the first is, that the ends retract too far to enable us to bring them properly together, and the second, that the wound nearly always suppurates; an occurrence eminently inimical to adhesive action. All the earlier operations of tenotomy that were performed according to this principle, failed in consequence of the violence of the resulting inflammation.

The *treatment* of a divided tendon, then, with an open wound, is very different from that where the wound is subcutaneous. In the latter, the application of a bit of adhesive plaster to the puncture to exclude the entrance of the air, and a little attention to rest and position, make up the whole sum of the surgeon's duty. In the former, on the contrary, the cut ends must be carefully approximated by the silver suture, the rest of the wound being firmly closed; or the limb with which the tendon is connected must be placed in the most thoroughly relaxed position possible, in order to approximate its extremities, and thus afford them an opportunity of reuniting, an occurrence, however, which, I am sure, will rarely take place under any circumstances, however propitious. The experiments of Dr. Levert, of Mobile, performed many years ago, prove that union between the divided ends of a tendon will be much more likely to proceed kindly and satisfactorily, when the parts are held in contact by a metallic suture than by an ordinary one. My opinion is that practitioners have not profited enough by the results of these researches. The recent introduction of silver wire, by Dr. Sims, into our surgical armamentarium, will, no doubt, tend to re-excite attention to them.

The surgeon is sometimes consulted on account of an ununited tendon, with an intervening gap, perhaps, long after the external wound has healed. Under such circumstances, it has been proposed to puncture the retracted extremities subcutaneously, and it has been alleged that such a procedure is not only safe, but generally quite successful. Safe it undoubtedly is, but, as to its being successful, that is an utter impossibility, unless, what seldom happens, the two ends remain in close proximity with each other. The proper remedy is to expose the parts by a free incision, and, having pared the retracted extremities, to unite them with silver wire.

2. *Rupture.*—Tendons are sometimes torn away from their sheaths along with the fleshy fibres into which they are inserted, hanging, perhaps, merely by one extremity; when this is the case, it would be useless to replace them, even if this were practicable, as there would be no likelihood whatever of reunion; on the contrary, severe inflammation and sloughing would be inevitable.

When a tendon is ruptured subcutaneously, a loud snap, like the crack of a whip, is generally heard at the moment of the accident, especially if the cord be a large one; the part is instantly deprived of its functions, and a well-marked gap, interval, or hollow is perceptible at the site of the injury. More or less inflammation follows, and a long time usually elapses before the patient regains the use of the affected limb. The tendon which is most liable to suffer in this way is that of the heel, its rupture being generally caused by violent muscular exertion, either for some special effect, as in the case of persons on the stage, or for the purpose of saving the body from a fall, as when the individual makes a false step.

The treatment of a subcutaneously ruptured tendon must be conducted by rest and complete relaxation of the affected structures, so as to enable us to bring the divided ends as closely together as possible. To effect this to the best advantage, special apparatus is generally required, as well as the greatest attention and vigilance on the part of the practitioner. The time necessary for obtaining satisfactory union varies, on an average, from six to eight weeks.

3. *Dislocations.*—The tendons are sometimes dislocated, or thrown out of the grooves in which they are naturally situated, in consequence of the laceration of the connecting ligaments, or retaining bands. The accident, which is most apt to befall the tendon of the two-headed flexor of the arm, as it runs along the bicipital groove of the humerus, is generally attended with severe pain at the site of the injury, inability to move the affected limb, and more or less discoloration of the integuments. Considerable swelling often follows, and, if the accident is overlooked, permanent lameness may result. Replacement should be effected as speedily as possible, and it is gratifying to know that this is usually quite easy, provided the true nature of the case is recognized soon after its occurrence.

4. *Hypertrophy.*—Finally, the tendons are occasionally the subjects of hypertrophy, exhibiting an irregular, knotty appearance, which is not only unseemly but sadly productive of discomfort. The affection is most common in gouty, rheumatic, and syphilitic persons, and is usually very readily detected both by touch and sight. The proper remedies are removal of the exciting cause, the exhibition of iodide of potassium, either alone or in union with mercury, and sorbefacient applications.

5. *Thecitis.*—Inflammation of the sheaths of the tendons, technically called thecitis, may originate as an independent affection, or, as not unfrequently happens, it may begin consentaneously with inflammation of the parts which it surrounds and lubricates. In either event, the disease is often of a much more serious character than is generally imagined, nothing short, perhaps, of permanent lameness and deformity being the result. Various causes may give rise to thecitis; thus it is occasionally induced by gout, rheumatism, syphilis, and exposure to cold. On the other hand, it often supervenes upon external injury, as a sprain, blow, puncture, or contusion. In the hand and fingers it is frequently met with as a consequence of dislocation of the wrist-joint, or fracture of the lower extremity of the radius and ulna. In regard to its character, it may be acute or chronic; more generally perhaps the latter than the former. Once fairly established, it is commonly removed with much difficulty, and is liable, as just stated, to be followed by the most disastrous consequences.

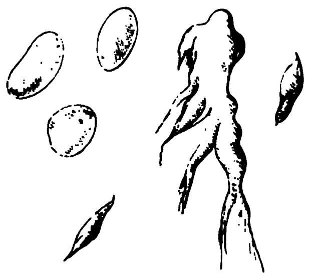
The most common sites of thecitis are the sheaths of the tendons of the fingers, the wrist, elbow, feet, ankles, and knees; the disease may occur by itself, or in union with inflammation of the burses and the lining membrane of the neighboring joints. In thecitis of the hands and fingers it is seldom that the disease exists except in this association, especially when it has been caused by a sprain, dislocation, or fracture of the radio-carpal articulation. Under such circumstances, as I have had frequent occasion to notice, the inflammation is extremely apt to extend to the sheaths of all the tendons, as well as the joints of the fingers, rendering them stiff, tumid, and exquisitely painful. If the case be neglected, misunderstood, or improperly treated, the whole hand becomes rigid, and the fingers wasted and attenuated, presenting more the appearance of the claws of some of the inferior animals than the organs which represent those parts in the human subject. The pain accompanying this form of thecitis often reaches as high up as the axilla, and I have known it to be so distressing at night as to deprive the patient completely of sleep for days together.

Thecitis, although apparently a trivial disease, assumes a most important character when it invades a number of thecæ simultaneously, or successively, and the gravity of the case is greatly augmented if there is at the same time considerable involvement of the neighboring joints, as when the attack takes place in the hands and fingers. Hence no time should be lost, and no pains spared, to get rid of the inflammation before it has produced any serious structural changes, particularly firm and extensive adhesions of the thecæ to their tendons. Leeches and tincture of iodine, either alone or in union with saturnine and anodyne fomentations, are the chief topical remedies upon which reliance is to be placed, while the patient is freely purged and restricted in his diet. Venesection and antimony will be necessary if the case prove obstinate. If the disease is found to be associated with a gouty or rheumatic state of the system, wine of colchicum will be of service. In thecitis dependent upon a syphilitic state of the constitution, recourse must be had to iodide of potassium.

If the parts have become stiff in consequence of firm adhesions, the hot and cold douche, followed in immediate succession, along with frictions with sorbefacient liniments, embrocations, or unguents, steady, systematic passive motion twice a day, and the application of the bandage to support the affected structures, will gradually, though in general not under several months, effect restoration. In obstinate cases a mild mercurial course may become necessary, on the same principle that such a plan is occasionally adopted in inflammation of other tissues attended with plastic effusions and morbid adhesions. When the disease is located in the hand, I have generally found it expedient to bandage each finger separately, and to support the member upon a carved splint. In short, in many of these cases nothing but the most zealous and determined perseverance will enable us to effect a cure.

6. *Ganglion.*—A ganglion is a small circumscribed cyst, situated along the course of a tendon, to which it is intimately united. Composed of a single layer, which rarely exceeds the thickness of the dura mater, it is filled with a thin, yellowish fluid, more or less ropy in its character, and bearing a very strong resemblance, in its general features, to olive oil, the white of an egg, or a solution of gum Arabic. In cases of long standing, the contents of the sac are sometimes nearly entirely solid, consisting of a thick ropy substance, of a dark color, not unlike currant-jelly; of masses, apparently, of semi-organized lymph; or of small bodies, similar, in shape and size, to cucumber seed. In a ganglion of the hand upon which I operated two years ago, I observed the singular looking bodies sketched in the accompanying cut, fig. 194. They appeared to be in different stages of development, and were evidently merely so many masses of lymph, which had been originally attached to the inner surface of the sac, but had become

Fig. 194.



Fibroid bodies of a ganglion.

separated in consequence of the continual friction of the tendon to which the sac was connected.

The volume of the cyst varies from that of a pea to that of a pigeon's egg; it is of a globular or ovoidal shape, somewhat elastic, perfectly movable, free from pain, and unaccompanied by any discoloration of the skin. A sense of stiffness and of uneasiness, felt chiefly along the course of the tendon on which it is situated, sometimes attends its formation, and induces the patient to apply for advice. I have never known a ganglion to suppurate.

The tumor is most common in the female, and is met with chiefly along the extensor tendons on the back of the hand, wrist, and lower extremity of the forearm. I recollect seeing, some years ago, a case where it was situated over the radial artery, the pulsations of which were so thoroughly imparted to it as to induce the belief, on the part of several physicians who examined it, that it was an aneurism of that vessel. In 1854, I operated before the medical class of the University of Louisville, upon a young woman who had two tumors of this kind, each of the size of a small bird's egg, upon the dorsal surface of the foot.

How this cyst is formed is still a mooted point. From what I have seen of it, I am inclined to regard it merely as a sacculated expansion of the sheath of the tendons, and not, as some pathologists do, as a new formation. From the fact that it is most common in hard working people, it, doubtless, owes its origin to inflammation, although it is seldom directly chargeable to external violence.

The affection sometimes appears at an early age. Not long ago I met with a case in a little girl only eight years old.

The most simple and certain method of treatment consists in rupturing the ganglion, and scattering its contents into the surrounding cellular substance, where they are in general speedily absorbed. I usually perform the operation with the thumb, but, if the cyst is old and very firm, it will be necessary to strike it with a book, or to pierce it previously by a subcutaneous puncture. Evacuation having been effected, a compress inclosing a piece of coin is tied upon the part, to promote the adhesion and obliteration of its cavity, the limb being maintained at rest until the resulting inflammation has subsided. When the ganglion is quite young, a cure may sometimes be procured by the application of iodine and systematic compression; but ordinarily such means are quite futile. Iodine is sometimes employed as an injection, in the same manner as in hydrocele; experience, however, offers nothing in favor of the treatment. When the ordinary means fail, the sac should be cut up as minutely as possible with a delicate bistoury, inserted subcutaneously, the operation being followed up by compression. Both excision and direct incision must be avoided, as likely to endanger the functions of the part.

SECT. III.—SYNOVIAL BURSES.

The synovial burses, bursæ mucosæ, or mucous pouches, exist in considerable numbers in various regions of the body, especially about the joints of the extremities, being small, semi-transparent sacs, occupied by a thin, unctuous fluid. They are for the most part interposed between bone and tendon, tendon and tendon, bone and skin, or tendon and skin, their object being to facilitate motion and ward off pressure. Hence, they are always most conspicuous in those situations which are habitually subjected to friction; and for the same reason they are occasionally developed to meet special contingencies arising from accidental causes, as the pressure of a shoe, crutch, or artificial leg. In club-foot synovial pouches are constantly found upon those parts of the foot which, being partially displaced, are compelled to sustain the weight of the body. Altogether there are about one hundred and fifty of these sacs in the natural state.

The largest and most important synovial pouches, surgically considered, are situated on the acromion process of the scapula, the space between the hyoid bone and thyroid cartilage, the condyles of the humerus, the olecranon process, the styloid projections of the ulna and radius, the tuberosity of the ischium, the great trochanter, the anterior superior spine of the ilium, the front of the patella, the condyles of the femur, the tuberosity of the tibia, the ankle, the calcaneum, and the heads of the first and fifth metatarsal bones, at their palmar aspect.

The principal diseases of the burses are inflammation, suppuration, induration and thickening, dropsical accumulations, and the development of fibro-cartilaginous concretions in their interior. It does not seem probable that they are ever the seat of any of the heteroclite formations; at all events, I have never met with any examples of them.

Inflammation of these sacs may occur either in an acute or a chronic form, the latter being, however, by far the more frequent. The usual cause is inordinate and long-continued friction conjoined with pressure. The disease may also be produced by blows, contusions, wounds, and punctures, and, in persons predisposed to gout, rheumatism, scrofula, and syphilis, by exposure to cold, or the sudden repulsion of the cutaneous perspiration. The housemaid's knee, and the collier's elbow, are examples of inflamed and enlarged burses produced under the influence of concentrated and protracted pressure; another instance, not less striking, is afforded by the bunion which so frequently forms over the inner surface of the metatarso-phalangeal articulation of the big toe.

1. *Acute inflammation* of the burses is generally productive of very severe suffering; the pain is tensive, throbbing, persistent, and greatly aggravated by motion, pressure, and dependency; the swelling, which is often considerable, is usually due partly to exterior deposits, partly to an accumulation of synovial fluid, the quantity of which is commonly very much increased; the skin is of a dusky reddish color, and deeply congested; and the functions of the affected structures are greatly impaired, if not completely arrested. Not unfrequently the swelling is of an œdematous or erysipelatous character, pitting readily under pressure, and being the seat of a dull, heavy, prickling sensation. In the more severe forms of acute bursitis, there is usually considerable constitutional involvement, the patient being feverish, thirsty, restless, and troubled with headache, loss of appetite, and other disagreeable symptoms.

Upon cutting into the affected sac, its inner surface is found to be deeply congested, and roughened with lymph, while its cavity is filled with a bloody, serous, or sero-oleaginous fluid, often in considerable quantity, especially if the disease has been of some standing.

Bursitis occasionally passes into *suppuration*, the symptoms, when this is about to occur, suddenly assuming a more severe form, just as when matter is about to be deposited in any other part of the body. The pus, which is usually of a thin, oleaginous character, intermixed with flakes of lymph, may find its way to the surface by ulcerative action, or it may discharge itself into a neighboring joint, although such an event is extremely rare, and is not likely to occur unless the joint has freely participated in the inflammation.

The *treatment* of this disease must be actively antiphlogistic; the part and system are kept perfectly at rest; leeches are applied to the affected surface, followed by anodyne and saturnine fomentations; the bowels, diet, and secretions are duly attended to; and the pain, which is generally severe, is controlled by morphine, or morphine, antimony, and aconite. If matter form, as denoted by an increase of pain and other symptoms, a free and early incision is made, the edges of the opening being kept asunder by a small tent to prevent reaccumulation. The milder forms of bursitis are generally easily combated by rest, cooling laxatives, and the application of the tincture of iodine, or, what is frequently preferable, a blister, large enough to extend over the affected surface, and retained sufficiently long to produce thorough vesication.

2. *Chronic inflammation* of the burses occasionally gives rise to remarkable structural changes, the most common of which is an indurated and hypertrophied condition, the result either of long-continued interstitial deposits, or of the formation of adventitious membranes. However this may be, the walls of the affected sac are sometimes found to be upwards of a quarter of an inch in thickness, and of a dense fibro-cellular consistence, without the slightest trace of its primitive characters. Under these circumstances, the cavity of the pouch is generally very small, filled with altered synovial fluid, and roughened upon its surface, so as to exhibit an appearance not unlike that of a honeycomb. Now and then shreds of lymph are stretched across its interior, dividing it into different compartments. In cases of very long standing, partial ossification of the cyst has been noticed, but such an occurrence is extremely uncommon.

These chronic enlargements of the burses are often very obstinate and troublesome, resisting not unfrequently the best directed efforts of the surgeon for their removal. The remedies upon which our chief reliance is to be placed are sorbefacient applications, as iodine and hydrochlorate of ammonia, blisters, mercurial inunctions, and systematic compression. When, these means failing, the tumor is productive of pain and other inconvenience, our only resource is thorough excision, care being taken, especially if a large joint be close by, not to cut too widely away from the morbid mass, lest the synovial membrane of the articulation be inadvertently pierced, or so much injured as to excite violent inflammation.

3. Another result of chronic inflammation of these bodies is an accumulation of their natural secretions, giving rise to what is called *dropsy*, of which one of the best examples is afforded in the so-termed housemaid's knee. The fluid, which varies in quantity from a few drachms to six or eight ounces, according to the size and situation of the affected burse, and the duration of the disease, is generally of a pale straw color, of a slightly unctuous consistence, and of a notably saline taste; now and then it is reddish, or brownish, and remarkably thick and viscid. It is readily coagulable by heat, alcohol, and acids, showing that it is essentially composed of albumen. The presence of the fluid is easily detected by the elastic and fluctuating character of the swelling, and very frequently a distinct friction sound and sensation can be perceived upon handling the tumor; if necessary, an exploring needle is used. The integuments are free from discoloration, there is no enlargement of the subcutaneous veins, and the principal inconvenience experienced by the patient is of a mechanical nature. Now and then there is a good deal of pain, but more generally simply a sense of soreness and stiffness.

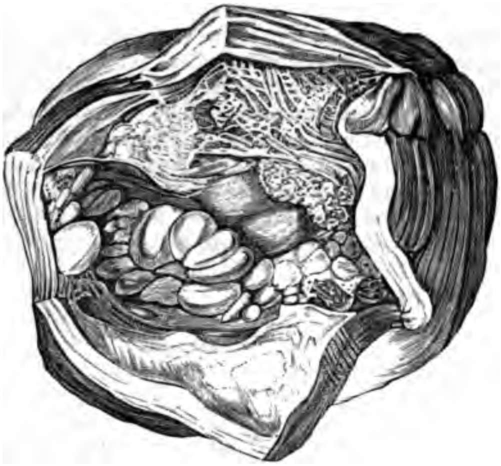
The size and shape of the tumor formed by these dropsical collections are subject to great diversity; in general, it does not exceed the volume of an orange, or a goose's egg, but there are cases in which it reaches the bulk of a fœtal head, although this is very uncommon. Its shape is generally irregularly rounded or ovoidal, with a compressed, flattened appearance.

Dropsy of the synovial pouches may often be relieved, in its earlier stages, by the diligent application of iodine, astringent and sorbefacient lotions, and, above all, by blisters; conjoined with rest, attention to the bowels, and the use of the bandage. In cases of long standing, however, such treatment is seldom of any permanent advantage, nothing short of a complete and radical change in the action of the secernent vessels answering the purpose. With this view, the water being drawn off with a trocar, the same remedies may be adopted as in the treatment of hydrocele, that is, injections of stimulating fluids, as tincture of iodine, nitrate of silver, or iodide of iron; or, what I deem better, because more certain, the introduction of a small seton, retained for a period varying from three to six days, according to the amount of the resulting inflammation. In either case, the part is carefully kept at rest, and every precaution used to prevent undue morbid action. When the tumor has become solidified and nearly of its original size, it is an evidence that the seton should be withdrawn. From three to six weeks will usually elapse before a complete cure is effected.

The operation by incision is sometimes practised in these dropsical accumulations; but as it is not only severe, but liable to be followed by violent inflammation, sometimes seriously implicating a neighboring joint, it ought, in my judgment, to be abandoned.

4. Intermixed with the fluid above described, or occurring by themselves, there are occasionally *loose concretions*, of a dense fibrous, fibro-cartilaginous, or cartilaginous consistence, which, from the peculiarity of their appearance, and the troublesome symptoms they occasion, have always been a source of interest with practitioners. They are generally of a light yellowish color, and of a flat oval form, not unlike small melon seeds. Their number is sometimes very remarkable, upwards of fifty having been extracted from a single pouch. The adjoining sketch, fig. 195, affords a good idea of the appearances of these bodies, as they are exposed on dissection, and also of the changes which the bûrse has undergone in consequence of their presence. When existing in considerable numbers, a careful examination will rarely fail to detect their true character. The symptoms which they occasion are such as usually attend chronic bursitis.

Fig. 195.



Fibroid bodies of a synovial burse.

How are these bodies formed? Two theories have been advanced upon the subject. According to one, they consist essentially of plastic matter, originally poured out in soft amorphous granules or flakes, which, increasing in size and density, are gradually moulded into a determinate shape by the pressure of the surrounding parts, as well as by the friction which they exert upon each other as they are pushed about from place to place in their confined situation. The other explanation is that they are originally connected to the inner surface of the sac, from which they receive temporary support and nourishment; but, finally becoming detached, in consequence of the constant friction to which they are subjected, they present themselves as loose bodies, of the shape and consistence here assigned to them. To my mind, this explanation is the more correct of the two; it is certainly favored by the results of dissection, in which we not unfrequently see some of these bodies still firmly adherent to the inner surface of the affected pouch, and by the analogy which exists between them and the concretions met with in some of the movable joints, which, there is reason to believe, are always formed in this manner.

The only way to get rid of these bodies is to effect their extrusion by free incision, a tent being afterwards placed in the bottom of the sac, to promote its obliteration.

Bodies, closely resembling small hydatids, have occasionally been found in these pouches. J. Cloquet met with an instance in which there were upwards of one hundred and forty, varying in size from one to three lines in diameter, nearly transparent, and of a lenticular shape. They were situated in a large burse, between the great trochanter and the tendon of the great gluteal muscle.

SECT. IV.—APONEUROSES.

The aponeuroses, considered by themselves, offer very little of interest in a surgical point of view, since their diseases are not only infrequent, but very imperfectly understood. From the intimate relations which they sustain, on the one hand, to the muscles, and, on the other, to the areolar tissue, it is obvious that there can be but few diseases or injuries, of a serious character, of these structures, without more or less mutual involvement. At the same time, it is evident that the aponeuroses, from their peculiar arrangement, must necessarily, in many cases, play a very important part in preventing the extension of morbid action to the muscles which they serve to inclose, just as the periosteum impedes the propagation of disease to bone, and, conversely, from bone to the surrounding textures. This barrier, of course, is often broken in both cases, and then the ravages of the morbid action will be likely to be both rapid and extensive, as we see exemplified in the worst forms of erysipelas, carbuncle, and traumatic inflammation, in which every variety of structure is rudely and indiscriminately assailed by inflammation, not unfrequently terminating, in a few days, in the destruction of an entire limb.

Acute inflammation of the aponeuroses is an uncommon occurrence, and is chiefly observed as a consequence of external injury, or as an effect of erysipelas, carbuncle, and whitlow. It is generally believed that gout and rheumatism are exclusively seated in the fibrous envelops of the muscles, but the probability is that the tendinous, ligamentous, and bursal structures are nearly always implicated along with them, the two diseases sometimes beginning in the former, and sometimes in the latter, but usually ultimately attacking the whole of them.

A bad form of inflammation of the aponeuroses is occasionally produced by punctured wounds, especially when occurring in the palm of the hand and sole of the foot, in persons of broken constitution, dissipated habits, or nervous temperament. The disease soon assumes an erysipelatous disposition, and leads to excessive suffering, both local and constitutional; occasionally it is followed by tetanus.

Inflammation of the aponeuroses manifests but little disposition to pass into suppuration, ulceration, or gangrene.

Chronic inflammation of these membranes is much more common than the acute, and leads to various alterations of structure, as thickening, atrophy, and induration. Sometimes we find them affected with slight ossification, the new substance presenting itself in the form of bony spicules; and I have met with cases where, from longitudinal pressure, they were remarkably attenuated, and pierced with numerous holes, giving them a sieve-like appearance.

I am not aware that the aponeuroses are ever the seat of any of the heteroclite formations; dissection, however, has shown that they are occasionally affected by them secondarily.

The *treatment* of aponeurositis must be conducted upon ordinary antiphlogistic principles. Anodynes must be exhibited in full and repeated doses to relieve pain and nervous symptoms; if plethora exists, and the local action is severe, blood must be taken from the arm and by leeches from the affected parts; the bowels must be freely moved; and recourse must be had to the saline and antimonial mixture. Free incisions are made if much tension be present, or the formation of matter be threatened; followed by medicated fomentations and emollient poultices.

Aponeurositis dependent upon a gouty, rheumatic, or syphilitic state of the system, must be managed according to the general principles of treatment laid down for the relief of these affections, by colchicum, iodide of potassium, and mercury, in combination with other suitable means.

CHAPTER III.

DISEASES OF THE LYMPHATIC VESSELS AND GANGLIONS.

THE pathologist can certainly not boast of his knowledge of the diseases of the lymphatic vessels; he knows, it is true, that they are liable to inflammation, but of the manner in which it is produced, and of the effects to which it gives rise, he is, in great measure, ignorant. That these vessels play an important part in various affections is extremely probable; but such are their excessive tenuity and the great delicacy of their structure that no one has yet been able to point out the character and amount of their participation. It has been supposed that at least one form of cutaneous disease, namely, erysipelas, essentially consists in inflammation of the absorbents, and it must be confessed that the opinion, although insusceptible of demonstration, is highly plausible.

SECT. I.—LYMPHATIC VESSELS.

Inflammation of these vessels, technically called *angeioleucitis* or *lymphatitis*, has hitherto been studied to most advantage in connection with external injuries, particularly punctured and poisoned wounds, of which it is by no means an infrequent consequence. Doubtless, the disease is sometimes idiopathic, or dependent upon internal causes, such as give rise to erysipelas and other bad forms of inflammation in the cutaneous and other tissues. When arising as a consequence of an abrasion, or the prick of a needle, as in sewing up a dead body, the affected vessels can be easily traced, as they pass beneath the skin, as small reddish cords, tense, nodulated, and painful to the touch, accompanying the principal veins, and extending as far as the nearest ganglions, in which they appear to terminate. The number of these reddish lines is variable; sometimes there are only two or three, while at other times there are as many as six, ten, or a dozen, forming a kind of band, from half an inch to an inch in width. Whenever the number is considerable, there is always a good deal of concomitant swelling; and the parts, feeling stiff, sore, and tender, readily pit on pressure, owing to the effusion of sero-plastic matter. In the more severe attacks of angeioleucitis, as those consequent upon inoculation with putrid or poisonous matter, the tumefaction soon becomes general, spreading rapidly over the whole limb, and the discoloration, losing its striated appearance, so characteristic of the disease in its earlier stages, also assumes a diffusive disposition. Arrived at this point, it is usually impossible to distinguish this affection from ordinary erysipelas, so closely do the two lesions resemble each other.

Occasionally the inflammation seems to take its rise in the deeper layers of vessels, when the discoloration is generally preceded by considerable induration of the subcutaneous areolar tissue, giving the part a kind of brawny sensation; by and by, however, red streaks appear in the skin, and then the disease follows pretty much the same course as when it begins in the superficial vessels.

However originating, the disease nearly always involves the neighboring lymphatic ganglions, causing them to enlarge, and to become tender, red, and painful. In some of the worst forms of angeioleucitis, the glands manifest signs of being diseased before the absorbents themselves are apparently implicated. Such an occurrence, although uncommon, is occasionally met with in inflammation of these vessels consequent upon dissection wounds.

Angeioleucitis no doubt sometimes passes into suppuration, and, perhaps, even into gangrene; but of these occurrences, as pure, uncomplicated affections, our knowledge is too imperfect to justify us in speaking positively.

The *symptoms* ushering in an attack of angeioleucitis are usually such as are denotive of constitutional depression, following pretty closely upon the injury sustained by the affected vessels. The patient, after having felt indisposed for some hours, seldom more than from twelve to twenty-four, is seized with chilly sensations, accompanied with flushes of heat, a disposition to yawn, headache, pain in different parts of the body, and a dry and contracted state of the skin. Sometimes the attack is ushered in by violent rigors, soon succeeded by high fever, and delirium. If the local affection be at all severe, the symptoms soon assume a typhoid character, the pulse becoming weak and frequent, the surface hot and dry, and the tongue covered with a brownish fur. The local distress, meanwhile, increasing, abscesses form in different portions of the limb, the matter being of a foul, unhealthy character, and disposed to spread extensively among the surrounding structures, in the same manner as in erysipelas and other bad forms of inflammation.

Angeioleucitis may be confounded with other diseases, particularly erysipelas and phlebitis, and the distinction is by no means always so easy as might at first sight appear. In fact, it can only be made out satisfactorily in the earlier stages of the complaint, the principal source of diagnosis being the red striated appearance of the affected surface, reaching from the seat of the injury up to the nearest lymphatic ganglions. In phlebitis, the discoloration is also linear, but the cords are much larger, firmer, more knotty, and more deeply seated; they are also less numerous, and there is not near so much involvement of the lymphatic glands. In erysipelas, the inflammation usually begins as a circumscribed affection, with diffuse, uniform redness, not striated, as in angeioleucitis, or in phlebitis.

In the *treatment* of this disease, the same general principles are to be observed as in the treatment of erysipelas and phlebitis, to which it bears so close a resemblance. The exciting cause being removed, such local and general means are to be employed as may seem to be best adapted to the exigencies of each particular case. Bearing in mind that, if the disease be at all severe, the symptoms will be likely soon to assume a typhoid character, the surgeon will take care not to deplete much, especially with the lancet and purgatives, lest he be instrumental in inducing fatal exhaustion, of which the danger may be already sufficiently great in consequence of the progress of the morbid action. Leeches may be applied along the course of the affected vessels, but not directly over them, if the disease is in its earlier stages, and the patient is robust and in the prime of life. They should be employed in considerable numbers, and be succeeded by warm fomentations, the whole limb being enveloped in flannel cloths wrung out of a strong solution of acetate of lead and opium, and kept constantly wet. The application of iodine will also be found advantageous; also, a long, narrow blister, stretched along the course of the affected vessels, and retained for a sufficient length of time to produce thorough vesication. If matter form, or great tension and throbbing exist, suitable incisions must be made.

The constitutional treatment must be regulated by the character of the general symptoms. Purgatives, to clear out the bowels and correct the secretions; iron, or iron and quinine, to improve the tone of the system and the state of the blood; and anodynes, to allay pain and induce sleep, with a properly regulated diet, will constitute the most reliable and efficient means.

If marked debility arise, brandy, wine, or porter, with nutritious broths, will be required. When the disease proves obstinate, or becomes chronic, a mild mercurial course will be beneficial.

Varicose enlargement of the lymphatic vessels has occasionally been noticed, although the occurrence is extremely uncommon. In a case mentioned by Carswell, of a young man, twenty-six years old, a tumor nearly as large as an orange existed in each groin, for which he had worn a double truss from his boyhood, under the supposition that he had hernia. On dissection, however, each tumor was found to consist of enormously dilated absorbent vessels connected with the inguinal ganglions. When cut into, instead of presenting a solid, compact structure, it had the appearance of a coarse sponge, most of the vessels being from one to three lines in diameter. The same phenomenon was witnessed, only in a more striking degree, in the lymphatics of the pelvic and lumbar regions. The spongy and elastic character of such a swelling ought to prevent any serious error of diagnosis. Hardly any treatment would be necessary in such a case. Excision might prove dangerous, and should not be practised without due deliberation.

SECT. II.—LYMPHATIC GANGLIONS.

The lymphatic ganglions are liable to inflammation, chronic enlargement or hypertrophy, carcinoma, tubercle, earthy degeneration, and fibro-plastic tumors.

Inflammation of these bodies, technically called adenitis, may show itself either as an acute or a chronic affection, and is of such remarkable frequency as to demand special consideration. In whatever form it occurs, it is most common in young children of a strumous predisposition, and is generally brought on by attacks of cold, or by some local irritation implicating the afferent lymphatic vessels. The disease, moreover, may be common or specific, of the latter of which illustrations are afforded in syphilitic bubo, in the bubo of plague, and in the swelling of the lymphatic ganglions of the axilla consequent upon dissection wounds and malignant pustule.

1. *Acute adenitis* is most common in the ganglions of the neck, jaw, and supra-clavicular region; it is also occasionally met with in those of the groin and axilla. The disease may be limited to one of these bodies, or, as is more generally the case, affect a considerable number of them; beginning as a hard, painful knot, exquisitely tender to the touch, and rapidly increasing in size, until, in some instances, it attains the volume of an almond or a pullet's egg. The increase in the size of the tumor is sometimes exceedingly rapid, as we often see in adenitis of the neck from exposure to cold, where a body of this kind, scarcely perceptible in the natural state, may, in the course of a few hours, acquire the size of a filbert or a small marble. As the disease advances, the swelling extends to the connecting areolar tissue, the skin becomes red and inflamed, and the parts pit on pressure. The discoloration is not unfrequently of an erysipelatous character. When the inflammation is fully developed, the local distress is usually very severe, and the constitution actively sympathizes with the suffering textures, the patient being feverish, deprived of appetite and sleep, and affected with constipation.

Dissection shows the affected ganglions to be of a deep reddish or brownish color, infiltrated with sero-plastic fluid, softened, lacerable, or easily crushed with the finger; the cellular tissue around is also abnormally vascular and infiltrated, and, in many cases, it seems to be the principal seat of the morbid action.

Adenitis may end in delitescence or resolution, pass into suppuration, or assume a chronic character. The occurrence of gangrene is very uncommon.

Adenitis sometimes vanishes in a few hours, either spontaneously, or under mild treatment. We often see enlarged and inflamed ganglions of the neck, or at the angle of the jaw, most rapidly disappear under frictions with ammoniated liniment, aided by hot drinks and immersion of the feet in hot water, or simply warming the feet near the fire. When the inflammation is more severe, an active purgative will be necessary, followed by a gentle diaphoretic, as one-fourth of a grain of morphia with one-half that quantity of tartar emetic. The diet must be light, and the part and system must be kept perfectly at rest. If the inflammation threaten to prove troublesome, or to pass into suppuration, leeches and medicated fomentations must be employed. In many cases the dilute tincture of iodine will be beneficial in cutting short the disease.

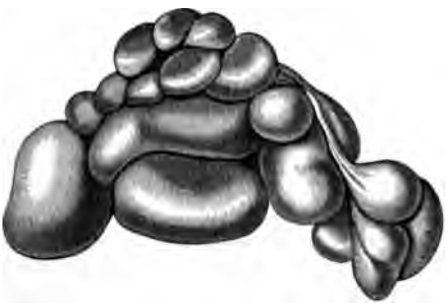
When adenitis passes into *suppuration*, matter generally begins to form from the fifth to the tenth day, sooner or later, according to circumstances, this event being generally most rapidly excited in young, weakly, or scrofulous children, with an impoverished state of the blood. The pus is not always situated in the enlarged ganglions; in many cases, in fact, it is limited, in great degree, if not entirely, to the neighboring areolar tissue. It is of a light yellowish color verging on greenish, thick, and often very copious; occasionally it is mixed with blood, and with the débris of the affected ganglions. Finally, the matter may occur as an infiltration, or as a distinct abscess.

The occurrence of suppuration is announced by increased heat, pain, redness, and swelling, along with a sense of throbbing, and by high constitutional disturbance, attended by chilly feelings, or even rigors, followed by fever and perspiration.

The *treatment* is strictly antiphlogistic. If the phenomena are clearly denotive of the existence of pus, an early incision is made, free and dependent, to favor thorough evacuation and prevention of reaccumulation. The operation is followed by warm water-dressing or an emollient cataplasm. The use of a tent will occasionally be required to maintain patency of the puncture.

2. *Chronic* adenitis is a very common occurrence; it generally succeeds to the acute variety of the disease, but there are cases in which it is seemingly, although not in reality, a primitive affection. However this may be, its effect is gradually to produce enlargement and induration of the affected bodies, until, in many cases, there is a complete subversion of the natural structures. In the earlier stages of the disease, the gland is of a reddish, brownish, mottled hue, considerably increased in size, and of a firm, fleshy consistence; by and by, however, it assumes a grayish or whitish aspect, becoming almost homogeneous, and cutting very much like an unripe apple or pear; in some cases it is quite soft and lacerable. When the transformation is very great, the hardness of the gland may be equal to that of scirrhus, with which it is then liable to be confounded. A distinct capsule, composed of dense cellular substance, generally surrounds the enlarged body, which is capable, under such circumstances, of attaining a volume equal to that of a small orange. When a number of such ganglions are agglomerated together, a large tumor is formed, of a hard, firm consist-

Fig. 196.



Hypertrophy of the lymphatic glands.

ence, more or less adherent to the neighboring parts, and of an irregularly lobulated appearance, as in fig. 196, copied from one of my preparations.

Chronically enlarged or hypertrophied lymphatic ganglions may occur in any part of the body; but they are most commonly met with in the neck, or about the lower jaw. In the internal cavities they are most frequently seen in the mesentery and pelvis, and at the root of the lungs. The effect which these bodies exert upon the structures among which they are situated, is principally of a mechanical character; compressing them, and so interfering more or less with the exercise of their functions. Thus, in the neck they may cause injurious pressure upon the trachea, vessels, and nerves; in the pelvis they may interfere with parturition by preventing the descent of the child's head; while in the lungs they may occasion suffocation by obstructing the entrance of air into the bronchial tubes.

Various causes may give rise to this affection; some of a local, others of a purely constitutional nature. In the neck, it is often occasioned by cold, or by disease of the jaw, teeth, gum, or tonsil; in the groin, by ulceration of the penis; in the axilla, by disorder of the mammary gland; in the mesentery, by irritation of the small bowel. The most efficient general cause is a strumous state of the system; but there is reason to believe that the lesion may be produced by anything that has a tendency to derange the general health, or to impoverish the fluids and solids.

Chronic enlargement of the lymphatic ganglions often continues for years, now advancing, then stationary, and now, perhaps, receding; in general, however, the disease is obstinate, especially when the structure of these bodies has undergone serious organic changes, in which case it is often extremely difficult, if not impossible, to reclaim them by any mode of treatment of which we have any knowledge.

The *treatment* of chronic adenitis is both constitutional and local. In the first place, the exciting cause is looked for, and, if possible, removed; the carious tooth is extracted, the ulcer on the penis healed. The general health is improved by attention to the bowels and secretions, and by a strict observance of the laws of hygiene. When plethora exists, detraction of blood, and the antimonial and saline mixture will be of service; under opposite circumstances, the proper remedies will be a nutritious diet, and alterant tonics, consisting of iodide of iron and quinine, bichloride of mercury, iodide of potassium, and cod-liver oil. When there is no contra-indication, minute doses of mercury in Huxham's tincture of bark will often be highly efficacious, but care should be taken not to carry it to profuse ptyalism. Tartar emetic also, given in small doses, as the tenth or twelfth of a grain, three times a day, will frequently prove eminently beneficial. In most cases a regular system of purgation should be maintained. The German practitioners are fond in this disease of the use of hydrochlorate of ammonia, administered in doses of from five to ten grains three times in the twenty-four hours. The article is a powerful sorbefacient, and is therefore worthy of trial, especially in cases refusing obedience to the more ordinary measures.

Among the more important topical remedies are leeches, and sorbefacient liniments, unguents; and embrocations, assisted by systematic and steady compression. These means must be employed with great caution and judgment, otherwise they will be sure to be productive of harm instead of benefit. All sorbefacient applications should, in the first instance, be of a mild character, their strength being gradually increased as the parts become more tolerant of their impression, and their peculiar effects are rendered more and more apparent. When the enlarged ganglions are favorably situated, compression will often be found a most admirable remedy; it may be applied with the pad of a truss, as in hypertrophy of the inguinal glands, or with a compress and bandage when it affects the glands of the neck, care being taken not to interfere with respiration. In obstinate cases, the application of a blister occasionally exerts a salutary influence, relieving the enlarged structures of engorgement, and stimulating the absorbent vessels so as to induce them to remove morbid deposits. The electric current has sometimes been advantageously used. Subcutaneous division of the enlarged glands, or comminution with the bistoury, has occasionally been practised, but the effects have not been such as to render a repetition of the operation at all desirable.

Finally, when the disease is intractable, our only resource is removal of the morbid mass, provided it is situated favorably for such a procedure. Such a step, however, should not be lightly taken, as it must often involve serious consequences, on account of the deep situation of the tumor, and its connection with important structures. In the cervical region, for example, the excision of a mass of enlarged and indurated lymphatic ganglions not unfrequently proves a most difficult, embarrassing, bloody, and hazardous operation. Removal, however, will be much facilitated, if the knife be kept close to the enlarged glands. Sometimes the enlarged and disintegrated organ may be pressed out bodily through a small opening in the integuments. When the diseased mass compresses the trachea or great vessels of the neck, and does not admit of removal, relief must be sought by the subcutaneous section of some of the constricting muscles, especially the sterno-cleido-mastoid.

3. *Carcinomatous disease* of the lymphatic ganglions is occasionally met with as a primary affection, more particularly the encephaloid variety. Scirrhus is extremely uncommon; colloid I have never seen here; while of melanosis I have witnessed only a few instances. As a secondary formation, cancerous disease of the lymphatic ganglions is extremely frequent.

Primary *encephaloid* is most common in the lymphatic ganglions of the groin, axilla, and neck; it occurs in both sexes, and at various periods of life, in children and adolescents, as well as in subjects after the age of fifty. In general, the disease arises spontaneously, but in some cases its origin may be distinctly traced to external injury, as a blow or kick. Its progress is usually very rapid, few persons surviving its attack longer than from six to twelve months. Beginning commonly in one of these bodies, as a hard, smooth, semi-elastic swelling, it soon extends to those in its immediate vicinity, thus often involving a whole group of ten, fifteen, or even twenty. In consequence of this arrangement, the tumor has generally a knotty, lobulated surface, and not unfrequently acquires a large bulk, equalling, or even exceeding, that of a fist. Soft and elastic at one point, it is hard and firm at another, while at a third it is occasionally almost of a fluid consistence. As it progresses it contracts firm adhesions to the surrounding parts, the skin becomes attenuated and discolored, and the subcutaneous veins assume that peculiar varicose disposition so common in encephaloid in other parts of the body. By degrees, the morbid mass breaks through its confines, ulcerating and fungating, and destroying life either by hemorrhage or by hectic irritation.

Examined after removal, the morbid mass is found to consist of a soft, brain-like substance, inclosed in thick, strong membranous cysts, representing the original capsules of the affected ganglions, but greatly condensed by the pressure of the contained matter. In addition to these cysts, there is generally a large quantity of filamentous tissue, intersecting the parts in different directions. A grumous looking, semi-organized substance often occurs in these tumors, and there are cases in which they contain serous cysts. In an instance of encephaloid of the axillary ganglions, which I observed in a man fifty-six years of age, there was a cavity of this kind which distinctly fluctuated under the finger, and gave vent, on being punctured, to upwards of eight ounces of sero-sanguinolent fluid.

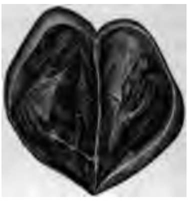
The diagnosis of encephaloid of the lymphatic ganglions is easily made; the only affections with which it is liable to be confounded being chronic enlargement and tubercular disease, from both of which it may be distinguished by the history of the case, and the rapid growth and soft consistence of the tumor. In chronic enlargement, the swelling is hard, and often involves a whole chain of ganglions; in tubercular disease the swelling, also very firm, generally manifests a disposition to suppuration, and is nearly always associated with other marks of the tubercular dyscrasia.

The proper remedy is early extirpation, although the disease will be certain to recur, and ere long prove fatal. Such a result will generally occur much sooner in young than in elderly subjects, and it has hence been a question whether they should ever be subjected to operation.

Primary *scirrhus* of the lymphatic ganglions is extremely uncommon; in the few cases in which it has hitherto been observed it occurred in the cervical, inguinal, and axillary regions of elderly persons. The disease is comparatively tardy in its progress, and the tumor, which is distinguished by its great hardness, seldom acquires any considerable bulk. My opinion is, that what is usually considered as scirrhus of these bodies is nothing but fibroplastic disease.

Melanosis of the lymphatic ganglions may occur as a primary affection; generally it is associated with melanosis in other parts of the body. I have noticed it in a few instances in the lymphatic ganglions of the groin and axilla, which, I believe, are its most frequent seats. It shows itself either as an infiltration, as in fig. 197, from a specimen in my cabinet, or as an irregular tumor, solid, inelastic, and of variable size and shape.

Fig. 197.

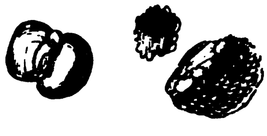


Melanosis of a lymphatic gland.

Tubercular disease of these bodies is met with chiefly in young subjects, before and soon after the age of puberty; most generally in children. Now and then it occurs in elderly persons, but this is very uncommon. Surgically considered, it is most frequent in the ganglions of the neck and jaw, and may be limited to one of these bodies, or, as is most generally the case, affect a large number of them, either simultaneously or successively. It often co-exists with tubercular disease of the lungs, joints, and other parts. This subject, however, having already been discussed in the chapters on scrofula and tumors, any further remarks respecting it here would be superfluous.

The lymphatic ganglions occasionally undergo the *earthy degeneration*, as in fig. 198, being converted into a soft, whitish substance, not unlike chalk. Such an occurrence is most common in the bronchial and mesenteric ganglions, but is also sometimes seen in those of the neck. Not long ago, I met with a case in which not less than five of the cervical ganglions had become completely ossified; they were of stone-like solidity, of a light brownish color, rounded, and from the size of a pea to that of a hazel-nut. The patient was a middle-aged, strumous female, and the ganglions, which formed a chain along the inner edge of the sterno-cleido-mastoid muscle, on the right side, had been affected from early youth. Their character was obvious to the slightest touch. Excision was easily effected. Such tumors need not be interfered with, unless they become a source of annoyance by their situation.

Fig. 198.



Cretaceous degeneration of the lymphatic glands.

The *fibro-plastic* tumor is sometimes found in these bodies, the proper tissue of which is replaced by a whitish, dense, solid substance, which, to the naked eye, as well as under the microscope, presents all the characteristic features of this morbid growth. The tumor generally occurs in young subjects, after the age of puberty, and is capable of acquiring a bulk varying from that of an orange to that of a fist. It is easily recognized by its firmness, and slow but steady progress, and by the absence of pain and constitutional involvement. The proper remedy is excision.

CHAPTER IV.

DISEASES AND INJURIES OF THE NERVES.

SECT. I.—WOUNDS AND CONTUSIONS.

NERVES, when divided, readily reunite, the connecting medium being plastic matter, which, being effused between and around the severed ends, is gradually solidified, and transformed into an analogous tissue, capable of transmitting the nervous current, although it does not contain any real nerve-substance. In order, however, that the connection shall be satisfactory, it is necessary that the interval between the two extremities be very short, otherwise the plasma will fail to effect the object, and each end will become expanded into a bulbous mass, having all the characteristics of a neuromatous tumor, similar to that which occasionally forms in the stump after amputation, and liable, like it, to become the seat of neuralgia. It is a curious fact that if a nerve be slowly divided with a ligature, the reunion of its extremities will generally be more rapid and complete than when the section is performed with a sharp knife; in the former case there is commonly very little retraction of the ends, whereas, in the latter, they sometimes separate to a considerable distance, thus requiring a large quantity of lymph to fill up the gap.

When a nerve is cut completely across, the parts to which it is distributed are necessarily deprived of their functions, an occurrence which, consequently, serves as a diagnostic sign of the accident. Thus, if the nerve be one of motion, the parts will be paralyzed, while, if it be one of sensation, they will be divested of sensibility. If the division be only partial, the loss of function will, of course, be partial also. In general, the structures beyond the seat of injury feel numb and heavy, with a sense of tingling, prickling, stinging, or burning.

Wounds of the nerves must be treated upon general principles. If there be no serious loss of substance, the divided ends should be as closely approximated as possible by attention to position, and, if necessary, by suture of the neurilemma, the needle and thread used for this purpose being of the most delicate kind. Such a procedure is much better than permitting the extremities to become separated from each other, as they are very apt to do when the suture is neglected, either in consequence of their retraction or of the interposition of other tissues. The operation, if carefully performed, will be free from pain, and, if one of the ends of the ligature be brought out at the nearest point of the common wound, no difficulty can arise in regard to its detachment.

A similar procedure may be adopted when a large nerve has been severed, but has failed to reunite, owing to the great distance at which the ends are separated from each other. An incision being made down to the nerve, the two ends are to be carefully retrenched, and then tacked together by several points of suture, apposition being favored by attention to the position of the parts.

Nerves when *punctured*, pricked, or partially divided, usually occasion severe pain, of a neuralgic character, extending up and down the affected parts, and attended with muscular weakness, perverted sensation, convulsive movements, and derangement of the general health. Such effects not unfrequently follow the operation of venesection at the bend of the arm, in consequence of injury sustained by one of the subcutaneous nerves. The proper remedy is complete division of the affected filament, either subcutaneously, or, when this is impracticable, by free incision. The operation, however, is not always permanently successful, owing to the deep impression made upon the nervous system, the effect of the lesion eventually becoming general. Besides, the divided extremities of the nerve are very apt to take on diseased action, either by being incorporated in the original cicatrice, or by being expanded into a species of neuroma. When this is the case, the proper procedure will be free excision instead of subcutaneous section.

Severe effects often follow *contusion* of the nerves, the parts to which they are distributed becoming numb, cold, withered, more or less painful, and, ultimately, almost entirely useless. Effects of this kind sometimes succeed to accidents of, apparently, the most trifling character. The nerves, so far as we can form an opinion without the light of dissection, soon become inflamed, and are often irretrievably ruined, being effectually and permanently disqualified for the performance of their functions. It is hardly probable that these effects are due, as has been conjectured, to mere concussion of the nerve-substance; if this were the case, they would be much more transient, as well as less severe. What corroborates the idea that inflammation is deeply concerned in the production of the secondary suffering is the fact that the parts, although seriously crippled at the start, do not evince much derangement until the disease is fully established in all its intensity.

Professor Willard Parker has recently described what he calls *concussion* of the nerves. He considers the accident as similar to concussion of the brain, the nerves receiving a shock eventuating in a sudden suspension of their functions. In the paper which he has published on the subject, in the New York Journal of Medicine for September, 1856, he has related six cases illustrative of the nature of the injury. When the paralysis, which is generally temporary, subsides, the affected nerves are in danger of being assailed by inflammation, which, if it cannot be prevented, must be treated in the usual antiphlogistic manner. A long time frequently elapses before recovery takes place, the nerves remaining weak, irritable, and incapable of performing their proper functions. The limb supplied by the affected nerves is soon fatigued and exhausted by exercise, and is the seat of a dull, aching, tired sensation, which is always aggravated by exertion, especially if carried beyond a given limit; in time, it becomes cold, atrophied, and, in great degree, useless. The general health also suffers, though the disease never proves fatal.

The proper treatment, in the first instance, is rest, absolute and unconditional; and, after the nerves have recovered from the immediate effects of the injury, passive exercise, dry friction, and attention to the general health, which, in the more severe forms of the accident, is always materially, if not seriously, impaired.

Severe pain is often produced by the *compression* of a nerve, without, so far as can be determined, any particular disease of the nerve itself. In aneurism, for example, of the larger arteries the patient often experiences extreme suffering from this cause. The pain, in this case, is either sharp and darting, as in certain forms of neuralgia, or of a burning, tearing, boring, or gnawing character, especially if there be at the same time erosion of the osseous and cartilaginous tissues.

SECT. II.—TETANUS.

The term tetanus is a generic one, employed to denote a peculiar affection of the nerves, characterized by violent contraction of the voluntary muscles, with irregular intervals of partial, though seldom of complete, relaxation. Different names have been devised to designate the disease, according to the nature of the predominant local symptoms occasioned by the affected muscles. Thus, when the muscles of the lower jaw are spasmodically contracted, so as to prevent the patient from opening his mouth, the word *trismus* is employed, or, to use a common expression, the person is said to have locked jaw. When the body is bent forcibly forwards by the action of the abdominal muscles, the affection is denominated *emprosthotonos*, and *opisthotonos* when it is drawn backwards by the dorsal muscles. The term *pleurothotonos* is used when the body is drawn to one side. A distinction of much greater importance is that of tetanus into traumatic and idiopathic, acute and chronic. The disease occasionally comes on within a few days after birth, and is then designated as infantile tetanus, the *trismus nascentium* of authors.

In this country, especially in its more temperate latitudes, the surgeon has to deal chiefly with traumatic tetanus, the idiopathic variety being extremely infrequent. Cases of it, however, occasionally occur in the more tropical States of the Union, especially in South Carolina, Georgia, Mississippi, Florida, Louisiana, and Texas; while in the West and East Indies it is sufficiently common. The tetanus of new-born infants occurs chiefly in the southern and southwestern States of North America, in consequence, apparently, of injury sustained in the ligation of the umbilical cord. Infantile tetanus seems to be very common in certain portions of Europe. Thus, it is asserted by Dr. Joseph Clark, that in the year 1782, of 17,550 children born in the Lying-in Hospital of Dublin, 2,944 perished from this cause alone within the first fortnight after birth.

Traumatic tetanus, to which the ensuing remarks are more particularly intended to apply, is not peculiar to any age, to either sex, or to any particular pursuit; on the contrary, it is met with at all periods of life, in females as well as in males, and in all ranks and classes of society, from the most refined and affluent to the most filthy and impoverished. It has been ascertained, however, that the young suffer more frequently than the aged, and that it is particularly liable to occur in persons of a nervous, irritable temperament. Ill health, especially disorder of the digestive apparatus, grief, anxiety of mind, and whatever, in short, has a tendency to depress the energies of the system, powerfully predispose to its development. It is generally stated that men are more prone to traumatic tetanus than women, and the statistics that have been published on the subject would, at first sight, seem to warrant such a conclusion; but it will be found, upon more careful inquiry, that the difference is only apparent, not real, and that it is dependent upon the fact that females are much less obnoxious to the various exciting causes of the disease than the other sex. Blacks and mulattoes are more liable to tetanus than whites. In some portions of the West Indies the disease is almost exclusively confined to the colored population.

Causes.—The causes of traumatic tetanus are, as the term implies, various kinds of external injury, as punctured, lacerated, and contused wounds, burns, scalds, abrasions, compound fractures and dislocations, and surgical operations, as amputations and the excision of tumors. A number of cases have been recorded where tetanus was produced by salivation. Some of the most trivial accidents are, at times, sufficient to produce the disease. Thus, cases have been observed where it followed the application of the scarificator in cupping, the introduction of a seton, and the extraction of a tooth. Baron Larrey mentions an instance in which it was occasioned by the lodgment of a fish-bone in the fauces. Examples of tetanus, consequent upon the ligation of the iliac, femoral, and carotid arteries, have been recorded by Brodie, Dazille, and Dudley. Many years ago, I met with a case where it supervened upon the injection of a hydrocele, the man dying a few days afterwards. Tetanus has now and then followed upon parturition, and that, too, where the labor was apparently of the most simple nature. The fact is, in persons of a nervous, irritable temperament, any injury, however trifling, or insignificant in itself, may readily induce the disease, especially in hot and damp states of the atmosphere, or during sudden transitions from heat to cold. Exposure to cold draughts, by which the body is suddenly chilled, is, under such circumstances, extremely liable to provoke an attack.

The effect of cold air, when permitted to play directly upon the body, is well illustrated by an occurrence that took place after the battle of Ticonderoga, in 1758. The wounded were exposed the whole night after the action, in open boats upon Lake George, and the consequence was that nine of them died of locked jaw. During our war with Great Britain, most of those wounded by fire-arms on board the frigate Amazon, before Charleston, were attacked with tetanus on the fourteenth day, from a sudden change of very wet and cold weather following a long draught. Wounded soldiers, lying on damp or wet ground, are particularly prone to attacks of this disease.

The injury inducing the disease may be situated upon any part of the body. It was at one time supposed that lesions of the head and face were singularly exempt from tetanus, but more enlarged experience has demonstrated that, although it does not occur with the same relative frequency as when the cause is seated in other regions, yet its invasion after such accidents is by no means uncommon. Injury of the inferior extremity is more prone to be followed by tetanus than a similar affection of the superior extremity; and everybody knows how remarkably liable the disease is to supervene upon wounds involving the tendons and aponeuroses of the hands and feet, especially of the latter. Lesions of the nerves themselves are particularly dangerous in this respect, more especially when they are of a punctured character, or when they are limited to a partial division of their fibres and neurilemma, by a blunt instrument, as a piece of glass or a rusty knife.

The extent of the injury does not, so far as we are able to judge, exert any material influence upon the production of the disease, as it has been known to follow, on the one hand, the most insignificant scratch, and, on the other, the most frightful wound. I believe, in fact, that it may be assumed, as a general principle, that the danger of the occurrence of tetanus is, other things being equal, almost in direct ratio to the diminutive size of a wound. This is certainly true of a majority of the cases that have fallen under my personal observation, an apparently trivial injury, mostly a little puncture, having served as the exciting cause.

Symptoms.—The period which intervenes between the occurrence of the injury and the development of the disease, is liable to considerable variety; but the subject, unfortunately, has not been elucidated by reliable statistics. Enough, however, has been ascertained to prove that it ranges, in the great majority of cases, from four days to a fortnight. In some rare instances, well-marked tetanic symptoms have manifested themselves within several hours after the receipt of the injury, and, on the other hand, cases have occurred where the eruption did not take place under eight or ten weeks. What is remarkable is, that the disease occasionally does not appear until the wound which provokes it is completely closed, owing, doubtless, to some lurking irritation in the nerves of the affected parts.

Although tetanus sometimes comes on suddenly, with hardly any premonition, yet, in general, the attack is preceded by various anomalous nervous sensations which but too surely announce its approach. The most important and reliable of these precursories are, a sense of *malaise* or universal uneasiness, aching in the muscles, stiffness about the lower jaw, pain in moving the head, and difficulty in protruding the tongue. If there be a wound, it commonly puts on an unhealthy appearance, discharging a thin, sanious fluid, and manifesting no further disposition to heal. After these symptoms, which are often attributed by the patient to the effects of cold, have continued for a variable, but usually a very short, period, others, more bold and decisive in their character, set in, leaving no longer any doubt respecting their true nature. The jaw now becomes firmly locked; the faculty of mastication is completely abolished; attempts at deglutition excite spasm in the throat, with a sense of impending suffocation; and there is an indescribable distress in the precordial region, extending from the ensiform cartilage backwards towards the spine, as if the chest were tightly encircled by a cord. The muscles of the back and abdomen are rigidly contracted, and, in no long time, those of the extremities become similarly affected. When their action is very violent, the spinal muscles may shorten themselves so much as to draw the trunk into a distinct arch, the body resting only upon the occiput and heels, the affection thus constituting the variety of tetanus called opisthotonos. The opposite state of this, emprosthotonos, is extremely uncommon; for, although the abdominal muscles are usually very firmly contracted, being often as hard as a board, yet it is seldom that they are able to counteract the extensor muscles of the back to such a degree as to bend the head and chest forwards. The disease having reached this stage, may be said to be completely and characteristically established. Frequent spasms now occur, convulsing and agitating the whole frame, and greatly increasing the general suffering. The teeth are firmly clenched; the eyes are fixed in their sockets, and have a wild, unnatural expression; the nostrils are expanded; the corners of the mouth are retracted; the countenance has an old, haggard, and withered look; the respiration is laborious and hurried; and the smallest quantity of fluid is unable to descend the fauces and œsophagus. So great, in fact, generally, is the impediment to deglutition that the very sight of water is a source of suffering. The pain is usually very severe, particularly about the jaw, throat, chest, and spine; while the general sensibility of the surface is so excessive that the slightest breath of air is often sufficient to bring on violent spasms.

Fever is seldom present in traumatic tetanus, even when it has reached its height, although the thirst is generally quite considerable; the pulse, which rarely exceeds eighty, eighty-five or ninety in the minute, is soft and regular, except, perhaps, during the violence of the muscular spasms, when it may be considerably agitated, small and feeble; the tongue, at first moist, becomes gradually dry and brownish; the stomach is extremely torpid; the bowels are generally obstinately constipated; the urine is scanty and high-colored; and the skin is hot and bathed with a copious perspiration, which is occasionally very clammy and offensive, especially towards the latter stages of the disease. The mind is usually unimpaired.

Although such is the most common course of the disease, yet more or less irregularity occasionally arises, giving the symptoms somewhat of an anomalous character. Thus, there may be almost a complete absence of pain; the throat may be free from uneasiness; the respiration may be gasping, or performed with a sort of catch; the eyelids may be half closed; the orbicular muscle of the mouth may be firmly contracted over the teeth; and the extremities may remain completely relaxed. The skin is, occasionally, remarkably hot, the temperature, in some cases, having been found to range as high as 110° of Fahrenheit.

Diagnosis.—The diagnosis of tetanus rarely, if ever, presents any difficulties. In general, the history of the case alone is quite sufficient to determine its real character. The only disease with which it can be confounded is hydrophobia, but the symptoms of the two affections are so very different that none but a most heedless practitioner could possibly commit such an error. The period of latency in hydrophobia is, on an average, not less than a month, while tetanus is usually developed in from four to fourteen days from the infliction of the injury which provokes it. Besides, in rabies there is an absence of locked jaw and of opisthotonos, which constitute such striking features in tetanus.

One of the most valuable diagnostic symptoms of tetanus is the terrible distress in the precordium; it is usually described as of a painful, dragging nature, and is no doubt dependent upon spasmodic contraction of the diaphragm. Coming on early in the disease, it generally continues to its close, and is nearly always attended with opisthotonos, the head and shoulders being drawn, as it were, instinctively backward, to relieve pain and favor the introduction of air into the lungs. In tetanus, the muscular contraction is steady and persistent, though liable to frequent and sudden exacerbations; in hydrophobia it is clonic, occurring paroxysmally, and having distinct intermissions. In tetanus, swallowing is difficult, chiefly by reason of the impossibility of separating the jaws; in rabies, it is dependent upon spasm of the throat and œsophagus; in the former disease, the mind is calm and unaffected; in the latter, it is often powerfully excited, and, at times, even furious.

Prognosis.—The prognosis in traumatic tetanus is extremely unfavorable. In the great majority of cases death occurs from the third to the fifth day; and if we occasionally meet with an instance of recovery, the circumstance is to be regarded only as an exception to a general law of the mortality in this affection. In an experience of thirty-one years, I have seen but two cases where the patient escaped with his life, and then only after a protracted and painful struggle. When the disease has once fairly commenced, the tetanic spasms generally continue to recur, with more or less severity, until they prove fatal. There are no reliable signs which can serve to guide us in regard to the prognosis in this affection. The previous state of the general health, the age of the patient, and the character of the pulse, afford no clue as to the probable issue of the case. The young and the robust fare no better, in this respect, than the old and the infirm. Both alike perish from its attacks. The danger is undoubtedly always, other things being equal, in proportion to the violence and duration of the paroxysms, and it has been found that any tendency to chronicity is generally so much in favor of ultimate recovery; although patients sometimes live for several weeks, and then die from the effects of the malady.

The manner in which death occurs is not well, if at all, understood. In some instances, it is apparently caused by suffocation, from spasm of the muscles of the larynx; occasionally it results from mere exhaustion, life being worn out by the intensity of the suffering; and in a third class of cases, it may probably be induced by convulsions of the heart, interrupting the passage of the blood to the lungs and brain.

Pathology.—It might reasonably be supposed that a disease which is characterized by so much violence during life, would leave some traces of its existence after death; but to show how erroneous such a conclusion is, it is only necessary to refer to the fact that all the dissections that have hitherto been made of persons dead of this affection have utterly failed to throw any satisfactory light upon its pathology and morbid anatomy. Many statements have been reported with reference to these dissections that are entirely without foundation; in fact, in not a few of the cases, natural or accidental appearances have been confounded with morbid, and lesions have been described which existed only in the imagination of the examiners. From the circumstance that tetanus is essentially a nervous affection, the brain and spinal cord, as well as the nerves emanating from them, and even the great sympathetic, with its plexuses and ganglia, have all been most thoroughly scrutinized in numerous instances, and that, too, by some of the ablest men in the profession, and yet, notwithstanding all this, we are no wiser now in regard to the real lesions of this disease than our forefathers were centuries ago. The whole subject is, in truth, still a mystery. I have myself made several dissections of this kind, and have witnessed others, amounting, perhaps, altogether to eight or ten, without, in a single one, observing any morbid appearances that could justly be ascribed to the effects of the disease. It has been noticed in several instances that the nerves leading from the wound which caused the attack were in a state of inflammation, their substance and neurilemma being congested and discolored.

Of the true pathology of tetanus, then, nothing of a satisfactory nature whatever is known; that it is essentially an affection of the nervous system, or of the nerves of particular muscles, is a circumstance which must be admitted, from the symptoms which characterize it; but in what the peculiar change consists, or to what extent it is carried, are points in the history of the lesion of which we are completely ignorant. I am aware that numerous hypotheses have been framed in explanation of the subject, but the only merit which they possess is their ingenuity; any real value which they may have, it would be difficult to discover.

Treatment.—The treatment of this obstinate, and, unfortunately, too generally fatal, disease, is altogether of an empirical character. That this should be so is not surprising when we remember how completely ignorant we are of its pathology, and the fact that there is hardly an article of the materia medica, of any reputed efficacy, that has not been employed, either singly, or in various forms and modes of combination, for its relief. Although patients occasionally get well of this disease, and that under circumstances apparently the most desperate, yet, when the practitioner comes to analyze his treatment, in the true spirit of philosophy, he is generally compelled to confess his ignorance as to the share which his remedies may have exerted upon the fortunate event, and to acknowledge that accident, rather than his own skill, performed the cure. However this may be, it is certain that the disease sometimes yields to the most insignificant measures, or, rather, that it apparently wears itself out; and that, at other times, it resists the best directed efforts of the ablest and most experienced practitioner. The chances, indeed, of effecting any good, when the disease is fairly established, are very slender in any case, however mild. Hence, whatever is done should be done promptly, and with a view rather to a prophylactic result than to a curative one.

It cannot be expected that, in a work of this kind, I should be able to give even an outline of the more important remedies that have been suggested for the cure of this disease; I shall, therefore, content myself with a brief notice of a few of those which general experience has shown to be the most reliable, or most in consonance with the apparent condition of the part and system.

One of the first and most important indications in every case of traumatic tetanus is the removal, if possible, of the exciting cause, which is, of itself, occasionally sufficient to effect a cure. Thus, if any foreign body remain in the wound, or in contact with the living tissues, the surgeon cannot too speedily extract it, especially if there be already some evidence of approaching disease. Sometimes a vicious cicatrice may keep up the tetanic irritation. Many years ago, I attended, in consultation with the late Dr. Buck, of Louisville, a young girl of fourteen, who had locked jaw from having been accidentally hurt, nearly a month previously, in the right cheek by a small splinter. Although the substance was immediately extracted, yet the parts continued to be tender, being, at times, even quite painful, and in less than a week tetanus set in. When I saw the case, free use had already been made, without any material benefit, of anodynes and antispasmodics, along with an occasional purgative, and the cheek had been leeched and repeatedly painted with iodine; the girl was pale and feeble, and had lost her appetite. Upon examining the original site of the injury, I found a small circumscribed spot, exquisitely tender under pressure, and of almost fibro-cartilaginous hardness. This being carefully dissected out, no more paroxysms occurred; and in a few days, with the aid of iron and quinine, wine, and a generous diet, complete recovery ensued.

Amputation of the wounded part has occasionally been performed; and, judging from the statistics that have been published upon the subject, there is reason to believe that the operation has now and then proved successful. Nevertheless, there are, I presume, few surgeons who would be found to be so venturous as to remove a leg or an arm on the approach of such a disease, and none would certainly be foolish enough to attempt the expedient after it is fully established. In the one case, the possibility is that the affection might yield to other and milder means; and, in the other, the disease being no longer one of a local character, but diffused, as it were, through the system, it is difficult to see how amputation, however early performed, could be of any benefit in arresting the morbid action, unless it be upon the principle of substituting a fresh and clean wound for one of an inflamed and irritable character. An interesting case, bearing directly upon this point, fell under my observation, in 1848, in a patient of Dr. Mattingly, of Bardstown, Kentucky. The man, who was fifty years of age, was a stout, healthy farmer, of a nervo-sanguineous temperament, who, about five weeks previously, had the fore and middle fingers of the right hand, between the second and third joints, severely mashed by the passage of the wheel of a wagon, the phalanges being completely comminuted, and supported merely by a few shreds of integument. A physician residing close by where the accident had happened, removed the injured parts with the scissors, and binding up the ill-formed stumps, sent the man home, a distance of thirty-five miles. The parts soon became excessively painful, and at the expiration of the time above specified, well-marked symptoms of tetanus supervened. Five days after this, while the patient was under the influence of chloroform, I removed the mutilated fingers at the metacarpo-phalangeal joints, the whole hand being at the time exquisitely tender and painful, the tongue coated, the pulse hard and accelerated, and the system irritable from the want of sleep. After the operation, the man had tetanic spasms for several days, but they became gradually lighter, shorter, and less frequent, and, in a few weeks, all symptoms of the disease had entirely disappeared.

How far the recovery in this case was due to the amputation of the affected fingers, it would be difficult to determine; but it is reasonable to suppose that the operation was serviceable by ridding the system of a mass of irritation and disease, which, if it had been permitted to continue in operation, might have proved highly detrimental, if not destructive, to the patient.

In regard to the treatment of the *wound* itself, in tetanus, it cannot be doubted that prompt attention to it is a matter of great moment. Our remedies should generally be of the most soothing character, consisting of warm water-dressing, or emollient cataplasms, with a liberal admixture of laudanum, powdered opium, or, what is better than either, sulphate of morphia. If the parts are girded by inflammatory engorgement, or various kinds of deposits, as will be apt to be the case if the wound is of a punctured character, free incisions must be made, the knife being carried thoroughly through the tissues in every direction. A similar method should be adopted when there is reason for suspecting the lodgment of some foreign body. I cannot approve, in any case, of the practice, at one time so common, and perhaps not yet sufficiently exploded, of pouring irritating fluids into the wound, or of applying escharotics. Such a procedure is only calculated to increase the suffering, and to aggravate the disease.

I have no experience with the section of the *nerves* connected with the injured structures; an operation which is reported to have been several times performed successfully by foreign surgeons. Such a step could only be justified in the case of the smaller nerves, and then, I presume, all the good that would be likely to accrue from it might readily be accomplished by a free division of the affected parts. The section of the larger nerves would be followed by paralysis, which might be permanent.

Attention to the position of the patient's bed is a matter that should not be overlooked in the treatment of this disease. From neglect of this precaution, I have seen several lives lost that might, probably, otherwise have been saved. Exposure of the body to a direct draught is often, of itself, sufficient to bring on an attack of tetanus in a susceptible, nervous person; and, after the attack is fairly established, such an occurrence never fails to aggravate the spasms, rendering them both more frequent and violent. The atmosphere of the room should, moreover, be perfectly dry, experience having shown that moisture is extremely prejudicial in all affections of this description.

The most important *internal remedies* are such, undoubtedly, as are of an anodyne and antispasmodic character, of which opium, tartar emetic, aconite, camphor, assafœtida, and Indian hemp occupy the highest rank. They should be administered in large doses, with a view to an immediate and decided impression upon the general system, and should be given either by themselves or in various states and degrees of combination.

The most eligible preparations of *opium* are the acetated tincture and the salts of morphia, particularly the sulphate. Opium in substance is objectionable, on account of its insolubility, the stomach, under such circumstances, being extremely torpid, and unable to act upon it. For the same reason, a much larger quantity of laudanum and morphia is required to produce their specific effect than in ordinary disease. When the patient is young and robust, or when the spasms are violent and obstinate, the anodyne should be combined with tartrate of antimony and potassa, given in doses sufficiently large to relax the system. The latter remedy is sometimes employed by itself, and several cases have come to my knowledge where it seemed to have effected a complete cure. I am satisfied, however, that its efficacy will always be materially enhanced by a judicious combination of it with morphia. In the use of tartar emetic in this disease, it must not be forgotten that the torpor of the stomach renders it necessary to give it in much larger doses than under ordinary circumstances. If the practitioner were to content himself with the usual quantity, the effects would greatly disappoint him, and the case might, in consequence, proceed rapidly from bad to worse, without receiving any benefit from the remedy.

Aconite is a remedy of great efficacy as a depressant, and may be given as an adjuvant to morphia, or morphia and tartar emetic, in cases of tetanus attended with a robust and plethoric state of the system. It lowers the action of the heart, promotes perspiration, and relieves spasm. Veratrum viride, acting in a similar manner, may be used as a substitute.

Camphor and *assafœtida*, administered in large doses, occasionally aid in controlling the spasms in this disease, but they should never be trusted to alone. Their influence, as antispasmodics, is far inferior to that of morphia and tartar emetic.

Indian hemp, soon after its first introduction into practice, received a large share of attention in the treatment of this disease, especially from the East India practitioners, some of whom were at one time disposed to regard it as a specific. Subsequent experience, however, has greatly disappointed these expectations, and in this country very little, if any, confidence is placed in the remedy. I certainly have never derived any appreciable benefit from it in the few cases of tetanus in which I have employed it, although the trials in each were very fair. The preparation which is usually given is the extract, in doses varying from one to two grains, repeated every two hours, or even more frequently, the object being to produce and to maintain narcotism.

Great expectations were entertained, on the introduction of *chloroform*, that at length an effectual remedy had been discovered for the cure of tetanus, and there is no article of modern times which has been so generally employed in the management of this disease. Cases successfully treated by it have been reported by different observers; but how far they were really relieved by this agent is a question which has not been decided. It is certain, however, that it has generally signally failed to cure, although it is usually productive of relief to the spasms, which are a source of so much distress to the patient. It should be administered in the form of inhalation, with an abundance of atmospheric air.

Much comfort is often experienced from the use of the *vapor bath* in the treatment of tetanus; the steam should be conveyed, by means of a tube, from the spout of a tea-kettle, or other suitable apparatus, under the bedclothes, and may be advantageously medicated with laudanum, or laudanum and chloroform. The remedy possesses no curative agency.

Bloodletting and *mercury*, carried to the effect of salivation, were at one time much vaunted, on account of their supposed efficacy in the treatment of tetanus. They have, however, of late years, been entirely abandoned. The patient is certainly reduced sufficiently soon without venesection; and as to mercury, its use has, as stated elsewhere, been followed, in more cases than one, by the very disease which it was intended to cure, the saliva streaming at the time from the mouth in enormous quantities.

When much exhaustion exists, brandy, wine, and a generous diet are indicated, along with quinine and other corroborants. The profuse and exhausting sweats which so frequently attend the disease are best controlled by aromatic sulphuric acid, and frequent sponging of the surface with a strong solution of alum.

Whatever treatment may be adopted, proper attention should be paid to the bowels, which, as before stated, are generally excessively torpid, and, consequently, difficult to move. When the patient is in a condition to swallow, he may take ten grains of calomel, with double that quantity of jalap, every six hours, until there are free alvine evacuations. If the medicines are slow in their action, their operation may be promoted by the addition of a drop of croton oil, or by means of a stimulating injection, as spirits of turpentine and castor oil. Occasionally, the croton oil may be advantageously rubbed upon the abdomen. Severe purging should be carefully avoided, as, from its irritating and prostrating effects, it cannot fail to aggravate the complaint.

The treatment of tetanus by *counter-irritation* has, I believe, become in great degree obsolete. It was formerly thought, when the disease was supposed to be essentially connected with inflammation of the cerebro-spinal axis, that extensive and rapid vesication of the spine would afford valuable aid in combating the morbid action, and putting a stop to the violent spasms; and examples illustrative of the beneficial effects of this mode of treatment have been published by different observers. The remedy usually selected is either the common blister, caustic potassa, or the actual cautery. The late Dr.

Hartshorne, of this city, was in the habit of employing a solution of potassa, in the proportion of one drachm and a half to two fluid ounces of distilled water. It produces a powerful rubefacient effect, and may be applied by means of a cloth mop to a narrow line of skin, from the occiput to the sacrum. If the hot iron be used, it should be applied transcurrently. I have, however, great doubts in regard to the propriety of any measures of this kind, believing that they frequently aggravate the symptoms instead of relieving them.

When the disease is chronic, and the wound still open, but indisposed to heal, the best plan is to divide the parts freely with the knife, so as to relieve them of engorgement, and invite a more salutary action. It is under such circumstances that the *actual cautery* occasionally answers a good purpose. In a case which occurred some years ago, in the practice of Dr. W. D. Stewart, of Indiana, and the particulars of which he has kindly communicated to me, an immediate stop was put to the paroxysms by this procedure, after various other means had been tried, without any benefit, for nearly a fortnight. No spasms took place after the application, and the patient, a lad nine years of age, made a prompt and perfect recovery. The wound which had provoked the attack was a large, lacerated one, occupying the right side of the scalp, and extending down to the bones.

Anodyne and stimulating *liniments* applied along the spine have sometimes appeared to act beneficially, both in moderating the spasms and in eradicating the disease. Chloroform has of late been used a good deal in this manner, and several cases of its successful employment have been reported in the medical journals; among others, a very interesting one, by Dr. Hinkle, of Marietta, Pennsylvania, of a woman who suffered from tetanus consequent upon the bite of an eel. The treatment was conjoined with purgatives and antispasmodics, as cannabis Indica, valerian, and compound sulphuric ether.

Finally, should the patient be so fortunate as to survive the disease, the greatest care must be observed during his convalescence, lest a relapse occur, and destroy him, when he is apparently on the verge of returning health. The clothing should be warm, the diet light but nutritious, the bowels and secretions duly regulated, and exposure to atmospheric vicissitudes sedulously avoided.

SECT. III.—NEURALGIA.

Neuralgia is an affection of the nerves attended with severe, agonizing pain, often paroxysmal in its character, liable to occur in all parts of the body, and generally dependent upon some local irritation, or upon the joint agency of a local and constitutional cause. As it would be out of place in a work of this kind to treat of neuralgia in general, I shall limit my remarks here chiefly to the disease as it manifests itself in certain nerves, particularly those about the face, where the lesion not unfrequently becomes a subject of surgical interference.

Causes.—The causes of neuralgia are various and of the most opposite character. They are predisposing and exciting. Persons of a nervous, irritable temperament are generally supposed, and I believe correctly, to be more prone to the disease than any other class of individuals. Those who are inclined to be rheumatic also frequently suffer from it. It occurs in both sexes, but in what proportion has not been ascertained. In my own practice, which has been unusually extensive in all kinds of neuralgic affections, there has been a decided preponderance of male patients. This may, however, have been merely accidental, as most writers assert that the disease is more common in women than in men. No age is exempt from its attacks, although it is by far most frequent from the twentieth to the fiftieth year. It occurs in all countries and at all seasons of the year; but is most common in winter and spring in cold northern regions and in districts abounding in malarial exhalations. Cold and damp states of the atmosphere are especially favorable to its production. Like gout and rheumatism, the disease occasionally manifests a hereditary predisposition, and in quite a number of instances I have met with it in several members of the same family.

The exciting causes of neuralgia are of a local and general nature. Among the former, exposure of a nerve to the air, or its compression by some tumor, as an exostosis, or soft growth, is the most common. The most atrocious attacks of this disease are generally witnessed in the branches of the trifacial nerve, in consequence of caries of the teeth, laying open their cavity, and thus allowing the air and other irritating substances to come in contact with the denuded nerve within. Similar effects are often produced by the pressure of a dental exostosis, or by the mere thickening of the periosteum covering the fang of a tooth. Occurrences of a like nature often excite neuralgia in the bones. Sometimes the disease is awakened by the contusion of a nerve, occasioned by a blow, fall, or kick; by the irritation of an old, indurated cicatrice; or by the excitement induced by the presence of a foreign body, as a splinter of wood. In the face, neuralgia has been known to be caused by the lodgment of a piece of dead bone in the nose or antrum. A calculus will occasionally produce the disease in the bladder; so also will worms in the bowels, and the larvæ of insects in the frontal sinus. Neuralgia of the pelvic viscera is often induced by the pressure of a displaced uterus upon the surrounding structures.

A very common exciting cause of neuralgia is exposure to cold while the body is overheated and covered with perspiration. When the predisposition to the disease is very strong, the slightest draught of cold air will often bring on an attack almost instantaneously. Exposure to heat is less injurious, though it is also capable of exciting the disease, especially if it be concentrated for any length of time upon one particular locality, part, or organ.

Attacks of neuralgia are sometimes induced by gastro-intestinal irritation, as the presence of a redundancy of acid, indigestible food, worms, impacted feces, or an overloaded state of the bowels. The disease is not uncommon in dysmenorrhœa and in ulceration of the neck of the uterus, in spinal irritation, and in organic lesion of the brain.

Occasionally the cause is seated in the nerve itself, as when it is inflamed, partially ulcerated, or denuded of its natural coverings. After amputation, the stump often becomes affected with neuralgia in consequence of the extremities of some of the nerves being expanded into neuromatous tumors; and similar effects sometimes supervene upon the division of the nerves in cases of wounds, especially lacerated ones.

Finally, the occurrence of neuralgia, as a consequence of malaria, is familiar to every one. In the southern and southwestern States of the Union, where neuralgia of every form and grade is extremely prevalent, the disease, in the great majority of cases, recognizes no other cause. The attacks, under such circumstances, are generally of a distinctly intermittent type, very similar to those of intermittent fever, recurring once every day or every second day, and, after having continued with great severity for several hours, gradually going off, to reappear about the same period on the next day; each paroxysm being, perhaps, ushered in by chilly sensations, and terminating in more or less profuse perspiration.

Symptoms.—The nature of the pain in neuralgia is not always the same. In one case, it is dull, heavy, and aching; in another, acute and extremely violent; in a third, it resembles the pain produced by thrusting needles into the tissues; in a fourth, it is pungent, smarting, or burning; and in a fifth, it is sharp and darting, or like an electric shock, running through the parts with the rapidity of lightning.

The pain, whatever its character may be, is generally attended with more or less soreness and tenderness of the affected parts which sometimes pit on pressure, although they are seldom discolored. Finally, the pain may be concentrated, or diffused; that is, it may be strictly localized, or limited to one particular spot, and that perhaps very small; or it may be extended over the greater portion of a nerve, or even over its entire length.

It is important to bear in mind that the pain often breaks out at a point very remote from the one upon which the impression provoking the attack is made. Thus, supra-orbital neuralgia is often produced by disorder of the stomach, or of the stomach and bowels; a carious tooth has been known to give rise to neuralgia of the hip; and spinal irritation not unfrequently occasions neuralgia of the leg, heel, and foot. A very singular case has been reported where a severe attack of neuralgia of the left forearm could always be instantly excited by touching the meatus of the right ear.

Neuralgia is sometimes associated with rheumatism, and it is to this form of the disease that the term rheumatico-neuralgic is generally applied by nosologists. The combination is most generally met with in persons of an arthritic predisposition, usually affects the muscles, especially the intercostal and spinal, and is often exceedingly intractable, rendering the patient miserable for life, and at length wearing him out by the constancy of his pains.

Neuralgia often exists simultaneously in different parts of the body, and when once it is fairly established it is easily excited by the most trivial circumstances. Its progress is variable. In many cases it readily yields to treatment, and not unfrequently disappears spontaneously; on the other hand, it is sometimes a most intractable disease, worrying and fretting the patient, undermining his general health, and disqualifying him for business and enjoyment. In its worst forms the suffering is almost constant; whereas, in the milder, there are not unfrequently long intervals of complete, or nearly complete, exemption from pain. When the affection is contracted early in life, and proves rebellious, it is seldom entirely gotten rid of, whatever means may be adopted for its relief.

Pathology.—The pathology of neuralgia is not understood. It has generally been supposed that it consists in a mere exaltation of the sensibility of the nervous tissue, but if this were so it is hardly supposable that it would be so intractable a disease as it often is. The explanation may probably hold good in those cases in which the disorder is very transient, or of malarial origin. But in other and in the greater number of cases, it is probable that there is some degree of inflammation present, either in the nerve-pulp, or in the neurilemma, or in both, as is proved by the fact that the parts supplied by the affected nerves are generally more or less tender, œdematous, and even somewhat discolored; phenomena which are clearly indicative of an engorged and incited state of the capillary vessels with a tendency to effusion. In other cases, again, it may consist in a mere perversion of the nervous fluid, as when a nerve is compressed by interstitial deposits, or by causes acting upon its periphery, thereby interrupting the current across the seat of the obstruction.

Prognosis.—The prognosis of this disease may be gathered from what has been stated in the preceding paragraphs. It seldom proves fatal. Its course is irregular. It may last for months, years, a lifetime, the patient finally dying of some other disease. The most dangerous form is visceral neuralgia, which sometimes causes death by the constancy and violence of the pains.

Treatment.—The treatment of neuralgia must be deduced, in great degree, from the nature of the exciting cause, which should, therefore, always receive prompt attention, removing it where this is practicable, or modifying it where it is not, so as to render it as harmless and inoperative as possible. In neuralgia of the face, for example, it will often be found that the cause of the trouble is a carious tooth, upon extracting which the pain instantly vanishes. Neuralgia dependent upon the presence of an old, callous cicatrice, can only be successfully relieved by the excision of the offending tissues. Vermifuge medicines are indicated when it is caused by worms; antacids when it is excited by vitiated secretions of the stomach, and purgatives, when it is occasioned by an overloaded state of the bowels. Thus, it will be perceived that no single remedy, or class of remedies, is adapted to all cases; a fact which strongly suggests, in every instance, the importance of a most thorough and critical examination of the state of the part and system, with a view to the institution of a rational therapeutics.

It must not be expected, however, that the disease will always disappear upon the removal of the exciting cause. Generally, indeed, it will, and that very promptly and effectually; but there are cases where it is inclined to linger, with little or no mitigation, for an indefinite period, the affected parts being seemingly unable to recover their natural functions, either because they have become habituated to the morbid action, or because they have experienced some organic change which no treatment can reach.

The treatment of neuralgia is general and local, except when the cause is obviously of a purely local character, when general means may usually be dispensed with. Purgatives, a proper regulation of the diet, and antineuralgic remedies, as they are named, constitute the more important constitutional measures; while embrocations, leeches, vesicants, the endermic use of morphia, and section of the affected nerves comprise the more efficient and reliable topical agents.

There are few cases of neuralgia which are not benefited by the use of *purgatives;* sometimes, indeed, the disease promptly disappears under a few brisk cathartics. Their exhibition is particularly indicated when there are a coated state of the tongue, disorder of the stomach, a vitiated condition of the secretions, headache, pain and aching in the limbs, or an overloaded state of the bowels. The best articles will be blue mass, colocynth, and jalap, or the compound calomel pill, repeated every other night until there is a decided improvement in the general health. Emetics may often be advantageously exhibited, especially when there is evidence of biliary and gastric derangement. The pain is generally mitigated by their action, and sometimes completely removed the moment they begin to manifest their specific effect.

The *diet* must be plain and simple, easy of digestion, and adapted, in regard to its nutritive qualities, to the exigencies of each particular case. The plethoric will be benefited by abstinence; the pale and anemic, by good living. When the general health is much impaired, tonics, as quinine and iron, a generous diet, wine, brandy, porter, and ale, with exercise in the open air, will be of service. Sometimes a sea voyage, or a residence near the sea shore, is salutary.

There are several articles of the materia medica which may be considered as exerting, in some degree, a specific influence over neuralgic affections, and which have hence received the name of antineuralgic remedies. To this class belong quinine, arsenic, strychnine, aconite, and morphia, along with some other anodynes, and the different preparations of iron.

Quinine, the great antiperiodic in intermittent fever, is entitled to the highest rank in the treatment of neuralgia, particularly in that variety in which the paroxysms observe a regular diurnal relapse, with an interval of entire freedom from suffering. It may be administered by itself or in union with an opiate, and a few efficient doses are almost sure to break up the attack promptly and effectually. In my own practice, I seldom give less than ten grains at a dose, repeated every six or eight hours, until the affection is either vanquished, or the specific effects of the medicine are rendered apparent by the aural and cephalic distress. Some practitioners prefer smaller doses, but experience has shown me that they are less trustworthy, and that, at all events, a much longer time elapses before they put a stop to the disease. Quinine may sometimes be employed with much benefit when the affection is not of malarial origin, but in general its effects are not near so apparent in the former case as in the latter.

In chronic neuralgia, or in acute but obstinate attacks, *arsenious acid* is generally found to be one of our best remedies, given in doses varying from the eighth to the twentieth of a grain, three times a day, in union with an anodyne, or an anodyne and tonic. There are few cases of the disease, however obstinate, that will not be materially benefited by the use of this article, if administered with proper judgment and perseverance. The acid is far preferable, in every respect, as an antiperiodic, to Fowler's solution, being much less liable to cause nausea and anasarca.

With the value of *strychnine*, as an antineuralgic, every practitioner is familiar. I have used it, as such, for many years, and its effects have rarely entirely disappointed my expectations. The dose recommended in the books is much too large. I rarely give more than the twenty-fifth or thirtieth of a grain, and sometimes not even so much as that, thrice in the twenty-four hours. Extract of nux vomica is also employed for the same purpose, but is seldom productive of any decided benefit.

Aconite and *Indian hemp* are valuable articles in the treatment of neuralgia, although their efficacy has, I think, been greatly overrated. They may be exhibited in the form of extract, in doses varying from half a grain to a grain every six or eight hours, either alone or conjoined with other articles.

The use of *morphia* is absolutely indispensable in the treatment of neuralgic complaints, not so much as a curative agent, as for the purpose of controlling the excessive pain and inducing sleep. There are cases, however, which are radically cured by the persevering exhibition of this remedy, but then it is generally necessary to give it in large doses, and to sustain its action by carefully watching its effects. Protracted narcotism has occasionally vanquished the disease after all other means had failed, even to afford temporary relief. Several examples of this kind have fallen under my own immediate observation, and others have been mentioned to me by professional friends. For ordinary purposes the dose need not exceed a fourth or a third of a grain, and in chronic or subacute cases, I rarely give more than the tenth, twelfth, or fifteenth of a grain at a time, repeated at suitable intervals.

For many years past I have been in the habit of employing, with very happy effects, in a great variety of cases of neuralgia, a combination of some or all of the above articles, giving them in pill form three or four times in the twenty-four hours. The subjoined will serve as a type of such a formula.[1] It need hardly be added that the effects of the prescription should be carefully watched, as several of the articles are of a potent and even a poisonous character. If the system be anemic, two grains of sulphate of iron or of the valerianate of that salt may be incorporated with each pill. Carbonate of iron I never use, as it has always disappointed my expectations, even when I have administered it in large doses and for a long time, and my experience, in this respect, is, I believe, fully corroborated by the results of the observations of other practitioners. When the attack depends upon the presence of a redundancy of vitiated gastric acid, the solution of valerianate of ammonia will be found a highly efficient remedy, administered in the dose of a drachm every two or three hours until relief is afforded. Iodide of potassium has been much lauded as an antineuralgic; but although I have used it in many cases, I cannot recall to my mind a solitary one where it seemed to be really of any material service. If it ever does any good in this disease, it is when it partakes of a syphilitic nature.

---

[1] ℞.—Quiniæ sulph., ʒj;
Morphiæ sulph., gr. jss;
Strychniæ, gr. j;
Acid. arseniosi, gr. jss;
Ext. aconiti, gr. xv.
Mix, and make xxx pills; one to be given three or four times a day.

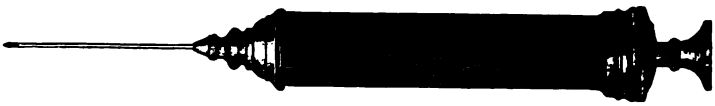
When the attack is of a rheumatico-neuralgic type, *colchicum* will be required, and will generally act more kindly and promptly than any other article. My invariable plan, however, is to give it in union with a full dose of morphia, as one grain of the salt with one drachm of the wine of colchicum, every night at bedtime, which will be found to be a much better practice than administering these substances in smaller and more frequently repeated quantities.

The *topical remedies* which particularly claim attention on account of their real or imputed virtues are counter-irritants, leeches, morphia, and the steam of hot water, either simple or medicated.

The only counter-irritants that, in my judgment, are at all admissible, in the treatment of this disease, are blisters, ammonia, and iodine. Setons and issues are out of the question, except in deep-seated, obstinate visceral neuralgia, when the latter occasionally prove beneficial, especially if made with the hot iron, directly over the seat of the pain, and if a free and protracted discharge be maintained. The moxa, formerly so much used, has of late years fallen into disrepute. Blisters are particularly valuable in inflammatory neuralgia; they should be retained until the epidermis is well raised, and they are the more desirable because the raw surface thus made may be advantageously employed for the endermic application of morphia. Temporary relief, but nothing more, occasionally follows the use of ammonia in the form of liniment, or of Granville's lotion, frictions with ointment of veratria, and painting the parts with tincture of iodine. Leeching is sometimes useful, by relieving congestion, and thus removing one cause of compression of the nerve-pulp; the operation being performed as near as possible to the seat of the disease.

The endermic application of morphia has been found highly beneficial in neuralgia, chiefly, however, in mitigating the pain. It may, as already stated, be simply sprinkled upon a blistered surface, be inoculated, or, what I greatly prefer, be injected subcutaneously. In the latter case, some care is necessary in regard to the quantity of the morphia used, as it occasionally evinces its narcotic effects in a very rapid and decisive manner. The operation which, I believe, I was one of the first to perform, but which has since been generalized by Mr. Wood, is executed with a tight syringe, fig. 199, having a very slender nozzle, which is inserted into a small puncture previously made in the skin of the affected parts, the subcutaneous cellular tissue being torn up with a common probe to make room for the reception of a drachm of solution of morphia, holding in suspension from a quarter of a grain to a grain of the salt, according to the exigencies of the case. The operation may be repeated once in the twenty-four hours, or oftener, if deemed neces-

Fig. 199.



sary. In the ordinary endermic application, the morphia does not penetrate to a sufficient depth; while inoculation is still more uncertain, and is by no means free from pain. I believe that the subcutaneous injection of morphia will be found highly serviceable in many cases, especially when the disease is distinctly localized, and rebellious to other remedies.

Hot applications, particularly moist ones, are generally beneficial in putting a prompt stop to the severity of the pain, especially if they are medicated with laudanum, or some other anodyne preparation. They may be used in the form of cloths wrung out of hot water, and covered over with oiled silk or gutta percha, to prevent evaporation; or in the form of steam conveyed directly to the part by means of a tube connected with a tea-kettle placed over a spirit lamp near the bed.

Section and *excision* of the affected nerve have often been practised for the cure of neuralgia, with results, however, by no means always satisfactory. Indeed, there is reason to believe, from the facts that have been published upon the subject by various surgeons, that both operations have generally proved unsuccessful; in many cases temporary relief ensued, but in nearly all the disease ultimately recurred with its former violence. I have myself performed a number of these operations, sometimes merely cutting the affected nerve across, and at other times excising a considerable portion of it, but the result has nearly always been unsatisfactory. Surgeons have not hesitated to remove sections of some of the larger nervous trunks, as, for example, the sciatic.

In facial neuralgia, where resection of the affected nerve is more frequently practised than elsewhere, the operation has, within the last few years, been pushed, if the expression be allowable, to an extraordinary extent by several American surgeons, Professor Carnochan having led the way. The results of his cases, three in number, will be found in an interesting paper on the subject in the American Journal of the Medical Sciences for January, 1858. The procedure consisted in exsecting the trunk of the second branch of the fifth pair of nerves, beyond the ganglion of Meckel, on account of severe neuralgia of the face. The portion of nerve removed, in two of the cases, was two inches in length, and in the other an inch and three-quarters. The result in all was most gratifying. Should the success of Dr. Carnochan be equally great in the hands of other surgeons, he will have conferred, by the boldness of his operation, an inestimable boon upon a class of patients heretofore considered as almost beyond the reach of relief.

The operation of exposing the second branch of the fifth pair, as performed by Dr. Carnochan, is severe and complicated, and requires, besides chisels and bone-nippers, two trephines, one three-quarters of an inch in diameter, and the other half an inch; the latter being intended for perforating the posterior wall of the antrum. The patient, being placed under the influence of chloroform, is seated upon a chair, with the head resting against the breast of an assistant, who maintains it firmly in this position. The infra-orbital foramen is then laid bare by two incisions, commencing above, near the inner and outer angles of the eye, at the inferior edge of the orbit, and terminating at a sharp point, about an inch below, opposite the furrow on the lower portion of the ala of the nose, the flap thus formed representing the shape of a V. The lip, being now everted, is next detached from the upper jaw, when it is completely divided, along with the cheek, by a vertical incision, extending from the inferior extremity of the V incision through its free border. By dissecting up the two large flaps thus marked out, turning one outward and the other inward, the whole of the front wall of the antrum, together with the trunk of the infra-orbital nerve, is completely laid bare. The crown of the large trephine is now applied immediately below the foramen, and an irregular disk of bone removed, so as to expose the cavity of the antrum. The lower wall of the infra-orbital canal is cut away with the pliers and chisel, while the posterior wall of the antrum is perforated with the smaller trephine. The trunk of the nerve is then isolated from the other tissues in the spheno-maxillary fossa, and carefully traced beyond the ganglion of Meckel, behind which, close to the round foramen in the sphenoid bone, it is divided from below upwards with a pair of blunt-pointed scissors, curved on the flat. The hemorrhage is slight, and the flow from the branches of the internal maxillary artery, in the spheno-maxillary fossa, is easily controlled by the compressed sponge.

In performing this operation upon the dead subject, I have found it quite easy to obtain a sufficiency of room for exposing the nerve, in its entire length, by carrying a curvilinear incision, from an inch and a quarter to an inch and a half in extent, across the cheek, beginning a short distance below the inner angle of the eye, descending towards the level of the ala of the nose, and terminating a little beyond and below the outer angle of the eye. Whatever plan of incision be adopted, care must be taken not to inflict any unnecessary injury upon the osseous tissues, or to expose the structures of the orbit too freely.

The inferior branch of the fifth pair of nerves may be exposed by perforating the ramus of the lower jaw about three-quarters of an inch behind the large grinder, five-eighths of an inch above the angle of the bone, and an inch and a quarter below the zygomatic process of the temporal bone. A curvilinear incision, with the convexity downwards, is made over the ramus, about two inches in length, and the flap thus made being dissected up, and held out of the way, a disk of bone, half an inch in diameter, is removed with the trephine. The nerve is then hooked up with a blunt tenaculum, and as much as can easily be got at removed with the scissors. Some hemorrhage necessarily follows the division of the dental artery, but this is usually easily arrested by the ligature or by compression.

The inferior dental nerve, at its exit from the jaw, will be found opposite the first bicuspid tooth, midway between the inferior border of the bone and its alveolar margin, and may be easily exposed by raising a semilunar flap of integument, with the convexity looking downwards to the neck. Should it be deemed necessary to follow the nerve into the dental canal, this can be readily done by the use of the trephine.

I do not deem it necessary to give plans and rules for exposing nerves in other parts of the body. Few surgeons, at the present day, will be so rash as to exsect any of the larger trunks of the extremities, and the smaller branches may generally be easily found and divided, or portions of them removed, by attention to the anatomy of the parts concerned.

SECT. IV.—PARALYTIC AFFECTIONS.

1. WASTING PALSY.

A peculiar affection of the muscles, consisting essentially in atrophy and fatty degeneration of their fibres, has recently been described under the name of wasting palsy, from the fact that wasting and loss of power of these structures are its most prominent features. The disease, first accurately delineated by Cruveilhier, has been studied with great care by several European observers, especially Aran, Duchenne, Wachsmuth, Eisenmann, Meryon, and Dr. William Roberts, the latter of whom has embodied all that is known respecting it in an admirable monograph, published at London in 1858. Of the contents of this essay I shall freely avail myself in the ensuing remarks.

Wasting palsy presents itself under two varieties of form, the partial and general; the first, as the name implies, being limited to particular muscles, or sets of muscles; whereas the other involves nearly all the voluntary muscles, those of mastication and those of the eyeball, including the elevator of the upper lid, being the only ones that escape its ravages. The involuntary muscles, however, remain altogether untouched, even in the worst cases and in the most advanced stages of the disease. Hence, the reason why the general health is usually so perfect amidst this wreck of the active agents of locomotion.

Of the causes of atrophy and palsy of the muscles, our information is too limited to permit us to speak positively. If occasionally their development has been clearly traced to the effects of cold, to rheumatism, or to excessive and long-continued fatigue, such as attends various mechanical pursuits, it is equally certain that, in the great majority of instances, no plausible reason can be assigned for their occurrence. In a few instances, the lesion has appeared to have had a syphilitic or strumous origin.

The time of life at which this disease occurs is variable; it has been noticed in young children, and, on the other hand, occasionally in old subjects; but the most obnoxious period would seem to be between twenty-five and thirty-five. Thus, in eighty-eight cases, analyzed by Dr. Roberts, the average period was thirty years and six months. General atrophy is not limited to any particular age, but attacks indiscriminately children, adults, and old persons; whereas the partial form rarely shows itself before puberty and after fifty. Both sexes are liable to it, but males suffer much oftener than females; although it is impossible to offer any correct data in regard to the relative frequency of the occurrence. The lesion has occasionally been observed in several members of the same family, and also in the offspring of persons who had themselves been its victims, thus exhibiting a sort of hereditary tendency.

The muscles that are most liable to suffer in this affection are those of the extremities, especially the upper. The wasting generally begins at one particular part of a limb, from which it gradually extends to another; but now and then cases are met with in which it attacks several points simultaneously.

It has been noticed that there is usually a tendency in certain muscles to suffer together, as if they were united by a close fellow feeling; thus it has been found that whenever wasting palsy occurs in the muscles of the hand, it is extremely liable to affect those of the forearm also; a similar disposition has been remarked in reference to the muscles of the shoulder and those of the arm. Moreover, experience has shown that when one limb is invaded its fellow of the opposite side is very apt to share the same fate.

The most important *symptoms* of this disease are wasting of the muscles and loss of contractile power, generally coming on in a slow, gradual, and stealthy manner. In the great majority of cases, indeed, the person is unconscious of the mischief that is taking place, until his attention is accidentally directed to the subject by a failure of the power of one of his limbs, especially the hand and foot. "The tailor discovers," says Dr. Roberts, "that he cannot hold his needle; the shoemaker wonders he cannot thrust his awl; the mason finds his hammer, formerly a plaything in his hand, now too heavy for his utmost strength; the gentleman feels an awkwardness in handling his pen, in pulling out his pocket handkerchief, or in putting on his hat. One man discovered his ailment in thrusting on a horse's collar; another, a sportsman, in bringing the fowling-piece to his shoulder." The wasting, at first very slight, progressively increases until the affected muscles are rendered perfectly soft and flaccid, and their substance is so much wasted that they are hardly one-fifth of the natural bulk; they are, in fact, completely withered, as if they had been starved, and deprived of all nervous influence. The loss of power is generally in proportion to the wasted condition of the muscles, proceeding gradually from bad to worse, until the parts are entirely disabled and useless, no effort of the will being capable of exciting the slightest action.

Besides the above more prominent symptoms, there are others of a minor and subsidiary character. These are fibrillary tremors, cramps and twitches, pain, and a remarkable susceptibility to cold.

Fibrillary tremors, or convulsive twitchings, are very common, especially in the earlier stages of the complaint; they are dependent upon irregular contraction of individual muscular fibres, and are, consequently, always absent when the disease has reached its full development. They generally occur without the consciousness of the patient, and may usually be readily excited by exposure of the affected parts to a current of cold air or water. Cramps are also very frequent; they come on at various intervals, and often constitute a source of real suffering, especially when they are accompanied with pain, which is present in about one-fourth of the cases. The pain may be slight and wandering, severe and fixed, or sharp and neuralgic, shooting about in different directions with the rapidity of lightning. In some instances it occurs in different parts of the muscular system, more or less remote from the seat of the disease, and is then apparently of a rheumatic character. Wasting palsy causes a remarkable sensibility to cold, especially to a cold, humid atmosphere, so that the patient requires an uncommon amount of clothing to keep himself warm and comfortable. Finally, the galvanic excitability of the muscles regularly diminishes with their decay, but is not wholly annihilated until they have completely lost their primitive structure.

It is remarkable that, amidst all this wear and ruin of the muscular system, the general health should uniformly remain unimpaired, even in the worst forms of the disease. The appetite and sleep are excellent; digestion is well performed; the bowels move with their accustomed regularity; and the functions of the kidneys are perfectly normal. The intellect is clear to the last, and the senses retain their wonted vigor. The only trouble which the patient occasionally experiences is difficulty of respiration, from involvement of the diaphragm.

The *progress* of the disease is generally slow, the muscles steadily decaying, until they are at length completely changed in their character; for months and even years they retain some contractile power, and are even susceptible of restoration. General atrophy is always a gradual affection; it seemingly begins in the partial form of the lesion, and is probably merely an aggravated state of it. When the disease has reached this crisis, the patient may be unable to use any of the muscles, excepting, as already mentioned, those of mastication and those of the eye.

The appearances revealed on *dissection* are highly interesting, and characteristic of the disease. The muscles, as might be expected, are wasted in various degrees; some slightly, others very much, and others, again, so completely as to be hardly recognizable, consisting merely of cellulo-fibrous vestiges, with no distinct trace of the original structure. The color of those that still remain is much faded, being pale red, rose, buff, or yellowish, according to the extent of the atrophy; and in all, or nearly all, there are well-marked evidences of granular and fatty degeneration, the former generally preceding the latter, although occasionally they exist independently of each other. Sometimes these changes are confined to one particular part of a muscle, as one-half or two-thirds of its belly, while the other portion retains its natural hue and consistence. Under the microscope, the striped primitive fibres are observed to have vanished, their place being supplied by granular matter and oil globules, and their investing tunic broken down and disintegrated.

The nervous system has been closely scrutinized in many of the reported cases of wasting palsy, but, thus far, nothing of a very satisfactory nature has been thereby elicited. It appears, however, to be well established that the lesions of the nervous system are of much less frequent occurrence than had been imagined. In some of the cases, indeed, there has been no perceptible change of any kind whatever; in others, there was softening or other disease of the spinal cord, either alone, or in conjunction with atrophy of the roots of the spinal nerves, and of their peripheral branches. In an instance, described by Schneevoogt, the great sympathetic with several of its ganglia was extensively wasted and converted into fatty matter.

In what does this disease essentially consist? It was very natural, before our knowledge of the affection was strengthened by the light of dissection, to refer its origin to lesion of the spinal cord, or of the cerebro-spinal axis, such as softening, or chronic inflammation; and from the fact that traces of this description have been observed in several cases, a number of pathologists have been induced to adopt this view. Others, however, maintain, and, as it seems to me, with a better show of reason, that the primordial cause resides in the peripheral nerves, which, becoming affected in a manner that has not yet been determined, undergo atrophy, or atrophy and fatty degeneration, so as to prevent them from conveying a sufficient amount of nervous fluid to the muscles to which they are distributed, and which thus, in their turn, fall into a similar condition. The principal reasons for this conclusion are, first, that in quite a number of the reported cases of this affection the spinal cord was found to be perfectly intact; and, secondly, that, as has been stated elsewhere, the affected muscles sometimes retain, in certain portions of their extent, their natural color and consistence, which could hardly happen if their degeneration depended upon disorganization of the great nervous centres. It may be assumed, then, that wasting palsy is essentially a local disease, originating in some lesion of the nerves of the muscles, and capable, occasionally, of involving the spinal cord secondarily.

The *prognosis* of this affection is generally unfavorable; the partial form is occasionally recovered from, the complete never. In the latter case death, which sometimes does not occur under several years, is usually preceded by great difficulty of respiration, in a paroxysm of which the patient suddenly expires. In partial atrophy, the disabled muscles, after having struggled on for many months, perhaps neither sensibly advancing nor receding, gradually awake from their torpor, and ultimately regain some contractile power, though never their full vigor.

The *treatment* of wasting palsy has hitherto been conducted too much upon empirical principles; a fact, however, which is not surprising when we consider the unsettled views that still prevail in regard to its pathology. If we assume that it is essentially a local affection, unconnected with any lesion of the spinal cord, it must be evident that our remedies should be directed mainly to the seat of the disease. This is accordingly what, I think, should be done. If there is any disorder of the general health, no time should be lost in correcting it. If the lesion can be clearly traced to a syphilitic or strumous taint of the system, as it has been in a few of the reported cases, the proper remedies will be iodide of potassium with bichloride of mercury; or, where a tonic effect is required, potassium with iodide of iron. Gentle purgatives will be useful when there is constipation with derangement of the secretions. The diet must be plain, simple, and unirritant.

The best *local remedy*, in the early stage of the disease, is, I am persuaded, a blister sufficiently large to cover the whole of the affected muscles, and retained long enough to produce thorough vesication. If decided improvement do not follow in a week or ten days, the application should be repeated. I have often obtained excellent effects from this remedy, and can therefore strongly recommend it as worthy of trial. The hot douche, immediately followed by the cold, will also be found serviceable, but to prove efficacious it should be aided by frictions with some stimulating embrocation, as spirits of camphor, or alcohol and ammonia. The cold douche alone is objectionable, on account of its depressing tendencies. Shampooing will be found useful, and should be practised several times a day. Galvanism has been highly extolled by Duchenne, Meyer, Gros, and others, and there can be no doubt that it has occasionally rendered good service. The current should be passed rapidly over the disabled muscles, taking care to return to each several times during the same sitting; it should be strong in proportion to the obtuseness of the parts, but be gradually diminished as the sensibility augments, otherwise over-stimulation may occur, and thus do harm instead of good. The application may be repeated at first every twenty-four hours, and afterwards twice a day.

Whatever mode of treatment be adopted, it should be combined with gentle exercise of the affected parts, to recall them, as it were, to a sense of their duty. They should, in fact, be re-educated by a system of careful training; but to do this to advantage, the efforts must be steadily and perseveringly continued for many months, if not for several years. If conducted in this way, I should have great hope of ultimate benefit. For some very judicious remarks on this subject, the reader is referred to a paper on paralysis by Dr. Batchelder, of New York, who has made this disease an object of particular study.

2. INFANTILE PALSY.

There is a variety of paralysis which may be briefly mentioned in connection with the preceding; occurring in young children, generally during the period of dentition, and which, in point of obstinacy and incurableness, is, if possible, still more deplorable. It may be called infantile palsy. Its attacks are usually sudden and unaccountable. The child goes to bed in the evening, perhaps to all appearance perfectly well; during the night, however, he becomes feverish and restless, and in the morning, on attempting to walk, he is unable to stand or use his legs. The limbs soon lose their round, plump appearance, the muscles are rendered soft and flaccid, the feet trail the floor, and the surface feels cold and numb, though sensibility is seldom entirely destroyed in any case, however extensive.

The seizure is much more common in the lower extremities than in the upper; very often it is confined to one thigh and one leg, but occasionally both limbs suffer, and now and then all four are involved, the child being perfectly helpless, and in the most pitiable condition. The paralysis is generally complete, but cases occur in which the little sufferer is still able to use certain muscles, although not with anything at all like their natural freedom and strength. When the upper extremity is attacked, the deltoid muscle is very liable to be affected, becoming remarkably soft and wasted, so that the patient finds it impossible to raise the arm or lift the smallest weight.

The cause of this variety of palsy is not always very evident; in general, however, it depends upon disease of the spinal cord, or of the cord and its membranes; probably inflammation, followed by effusion of lymph and serum, or softening of the nervous tissue. However this may be, the idea of such an occurrence is countenanced by the suddenness of the attack, the paralysis of all the muscles, not of a portion of them, as in wasting palsy, properly so termed, and by the remarkable obstinacy of the disease, most persons remaining crippled during the rest of their lives. If occasionally a recovery takes place, it is to be viewed rather as a rare exception than as a general occurrence.

The general health is seldom impaired in infantile palsy; the mind acts with its accustomed vigor, and all the bodily functions are well executed.

As the child advances in years, all the limbs, excepting the disabled ones, increase in size and strength, but the latter remain stationary, or dwindle away still farther, and thus form a striking contrast with the sound.

The *treatment* of infantile palsy must mainly be directed, in the first instance, to the spinal cord, by whose disease it has been provoked. For this purpose leeching, cupping, rubefacients, and blistering should be employed as soon as possible after the occurrence of the paralysis; and these should be followed, if the case is likely to prove obstinate, by a seton, or, what is preferable, because more efficient, by an issue with the actual cautery, applied, as nearly as can be, opposite the seat of the lesion, and made to furnish a copious supply of pus. If anything will reach such a case, it will be active and long-continued counter-irritation. Meanwhile, the muscles themselves must be rubbed and shampooed, and placed upon a course of careful training, as advised under the head of wasting palsy. If the general health is suffering, alterants and tonics are prescribed; the child is carried about in the open air, and special attention is paid to the bowels and secretions. As recovery advances, strychnine may be of service; but no benefit will be likely to accrue from its exhibition in the earlier stages of the complaint. Mercury has been strongly recommended in this disease, given in minute doses several times a day for several successive months; but, although such a plan of treatment is extremely plausible, I cannot say that it has ever been of any material benefit in the large number of cases in which I have employed it.

3. PARTIAL PALSY.

Besides the above forms of palsy there are some others, to which the term partial, transient, or anomalous may be applied, such, for instance, as loss of motion of one side of the face, one eyelid, one side of the tongue, or of the hand, forearm, arm, or shoulder, or even of the entire superior extremity. The subjoined facts will serve as illustrations of its character.

Pressure upon the nerves is liable to be followed by interruption of their functions, at one time temporary, at another permanent. A case recently came under my observation in which a man, aged thirty-five, suffered from partial palsy of the forearm and hand from having rested for two hours with his head upon the limb as he lay asleep upon the floor.

In another case, which came under my notice several years ago temporary paralysis of the left upper extremity was produced by the arm, thrown across the top of a chair, being compressed by the head while the man was asleep. Pressure of the head of a crutch upon the axillary plexus of nerves will occasionally lead to weakness, numbness, and prickling pain in the arm, hand, and fingers. Recently a youth of fifteen was under my charge on account of paralysis of the arm, consequent upon a fall on the shoulder from a railroad car, two months previously. The limb was instantly deprived of motion and sensation, and so continued up to the time of his visit. The head of the humerus had been thrown slightly forwards against the coracoid process, but it exerted no perceptible pressure upon the brachial plexus of nerves.

Paralysis of one side of the face from injury of the portio dura is occasionally met with; more generally the affection is caused by suppression of the cutaneous perspiration, from exposure to cold and wet; and we now and then meet with instances in which it is occasioned by disease of the petrous portion of the temporal bone. The subjoined case affords a good illustration of a very common form of facial palsy.

David Shepard, aged 18 years, blacksmith, of temperate habits, came under my treatment, in 1856, for paralysis of the left side of the face. The attack came on suddenly three days previously, without any apparent cause, soon after eating a moderately hearty dinner. He had been subject to frequent and severe paroxysms of headache, preceded by dizziness and vertigo. On the day, however, on which he was seized with palsy he had no suffering of this kind; in fact, he had never felt better. His appetite and sleep have always been good, and his bowels regular. The palsy was characterized by inability to move the muscles of the left side of the face, and to close the eyelids, accompanied with a want of sensibility of the integuments. The tongue, when protruded, inclined to the right side, and was deprived of feeling and taste, a lump of sugar, held in the mouth, making no impression on the affected side of the organ. The general health at the time was excellent.

In the *treatment* of these paralytic affections, special attention must be directed to the improvement of the general health, which is often seriously impaired, by the use of purgatives, alterants, and a proper regulation of the diet. In obstinate cases, a mild mercurial course is sometimes serviceable, especially when the lesion is dependent upon organic disease of the brain, or of the cerebro-spinal axis. The principal local remedies are leeches, blisters, stimulating embrocations, the veratria ointment and the hot and cold douches, followed by dry friction. Occasionally electricity proves beneficial.

CHAPTER V.

DISEASES AND INJURIES OF THE ARTERIES.

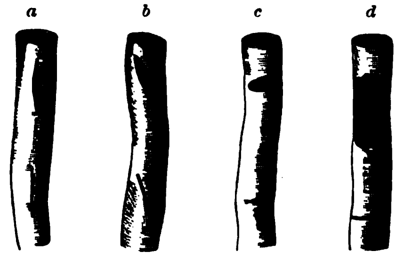
SECT. I.—WOUNDS AND HEMORRHAGE.

There can be no more terrible and appalling sight to a patient and his friends than hemorrhage from a divided artery, especially when the blood is gushing out in a full and angry torrent, threatening every moment to put an end to existence. There is something indescribably sickening and distressing in such a scene, from which every sensitive mind shrinks with dismay and bewilderment. The horror of the scene is increased a hundred-fold, when we are unable to afford the requisite relief. But the sight of blood is not only disagreeable to the common observer; there are few surgeons, however heroic, or well disciplined, who do not, at times, participate in this feeling. If it were not for the frightful hemorrhage which so frequently attends them, operations would be robbed of nearly all their terror, and few men would shrink from their performance. Fortunately, or unfortunately, however—for it is not easy to determine which—this is not the case; the slightest incision is often followed by profuse bleeding, and in the extirpation of tumors, in the removal of limbs, and in various other proceedings, the patient has reason, in many cases, to congratulate himself if he do not perish from the loss of blood. Some of the more serious accidents, as incised, gunshot, and punctured wounds, often prove instantly fatal from hemorrhage; or, if syncope should, luckily, ensue, and thus temporarily arrest the bleeding, death may occur subsequently, but not less certainly, from the same cause. It is for these reasons that hemorrhage has always been a source of so much anxiety to the surgeon, and that its study has engaged so large a share of his attention from the earliest ages of medical science down to the present time. It is, indeed, impossible for him to be too well acquainted with the subject, or too thoroughly prepared to meet its various, trying, and painful emergencies. The reflection, which must often arise, under such circumstances, that possibly all was not done that might have been done, if greater skill had been exercised, is well calculated to overwhelm the sensitive and conscientious surgeon, and to induce a degree of distress which no one, who has not himself experienced it, can possibly appreciate. I do not envy that man his feelings who, through ignorance, inattention, or indecision, allows his patient to perish from loss of blood when he ought to have saved him.

The characteristics of arterial hemorrhage are, first, the scarlet color of the blood, and, secondly, the peculiar manner in which it issues from the injured vessel; it spirts out in jets, synchronously with the contraction of the left ventricle, and not in a steady, continuous stream, as when it comes from a vein. This, however, is true only of the larger arteries; for, when the smaller branches are severed, their contents escape very much like those of a vein, only more forcibly, the fluid even then often projecting to a distance of several feet. When one of the principal trunks is divided, the blood is frequently sent with great violence to the top of the ceiling, or far across the room, to the horror and dismay of every one present. The consequences of the hemorrhage vary in different cases, and under different circumstances, being by no means always in proportion to the extent of the injury. When proceeding from a large vessel, or a considerable number of small ones, it may prove fatal in a few seconds, or, at most, in a few minutes. In general, however, the case does not progress in this wise; the patient, after having lost a certain quantity of blood, falls into a state of syncope, whereby the heart's action is temporarily enfeebled, and an opportunity is afforded to the blood to coagulate in the wound, and also around and within the artery, at least for a short distance. By and by, however, the system begins to show signs of reaction; color returns to the face, the extremities become warm, and the pulse reappears at the wrist. With these phenomena recurs the danger of hemorrhage; as the heart's action augments, the blood is propelled with increased vigor to every portion of the body, and presently, the temporary clot being washed away, the wound is reopened nearly, if not quite, to its original extent, thus permitting the blood to flow, if not copiously, at least in sufficient quantity to produce further exhaustion. Again fainting occurs, a new plug is formed, and for a time life is once more free from immediate danger; but this truce, like the first, is only of short duration; the same scene is re-enacted a second and a third time, until at last, in consequence of the repeated drain, the heart and the brain are no longer capable of supporting each other in the fearful struggle, and the patient sinks completely exhausted.

A person dying from repeated losses of blood, consequent upon the division of a large vessel, presents a fearful picture. His countenance is ghastly pale; his pupils are widely dilated; he pants and sighs for breath; his ideas are vague and confused; he is sick at the stomach and vomits; the extremities are icy cold; and the whole surface is covered with a profuse, clammy perspiration. The thirst is usually intense and unquenchable, the largest quantity of water failing to satisfy the urgent wants of the system; excessive restlessness and jactitation succeed; the patient calls loudly for cold air; paroxysm after paroxysm of swooning recurs; the pulse has, perhaps, already been long absent from the wrist; the eyes assume a glazed and fixed expression; the respiration grows more and more feeble; and death often steals on so imperceptibly as to render it difficult to determine the precise moment of its occurrence. During all this time, whether it embraces only a few minutes or hours, or whether it extends through several days, there is generally an entire absence of pain, the loss of blood operating as an anæsthetic.

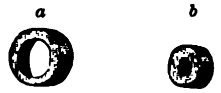
Fig. 200.



Plan of wounded arteries. *a.* A mere longitudinal slit, extending to an oval space. *b.* A similar wound, in an oblique direction, gaping more. *c.* A less wound transverse, with the proportional gaping great. *d.* A transverse wound of the same size as *a* and *b*, causing a very wide hiatus.

If we inquire into the nature of wounds of the arteries, we shall find that they do not differ, as it respects the weapons with which they are inflicted, from wounds in other tissues. Thus they may be incised, punctured, lacerated, contused, or gunshot, and it would frequently be difficult to determine which class is the worst, or the most certainly and speedily fatal. In regard to their size they present every possible gradation, from the slightest incision to the complete division of the vessel; the wound being either oblique or transverse in the latter case, but of various shapes when the lesion is partial. Occasionally the wound consists of a mere vertical fissure. The different appearances here alluded to are well displayed in fig. 200. The extent and character of the wound necessarily exert, as might be supposed, great influence upon the amount and duration of the hemorrhage, and therefore demand careful study.

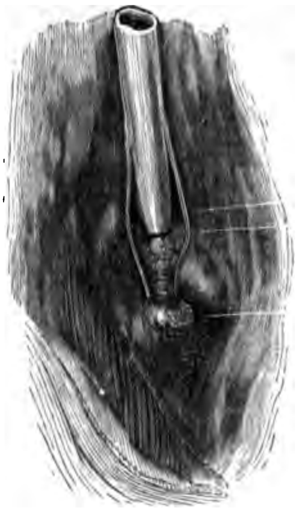
Fig. 201.



Contraction of a divided artery. *a.* The orifice of a dead artery. *b.* The orifice of a living vessel immediately after section.

When an artery has been completely cut across, there is an instantaneous and impetuous flow of blood, followed immediately by the retraction and contraction of each end of the vessel, as exhibited in fig. 201. The effect of this double action is to diminish the amount and force of the stream, but not to arrest it; instead of this it usually continues until a coagulum has formed upon the orifice of the artery, as well as in the parts immediately around, particularly in the loose cellular tissue constituting its sheath. In this manner a mechanical obstacle is opposed to the effusion of blood, but this would soon be washed away if it were not aided and fortified by the speedy development of a coagulum within the vessel, extending usually as high up as the first large collateral branch. These clots, of which the first bears the name of external, and the other that of internal, fig. 202, are the means which nature employs to put a stop to the hemorrhage; not, however, until, as a general rule, it has proceeded to the extent of causing syncope; a circumstance which is always, as was before intimated, eminently favorable to the coagulation of the blood, and, consequently, also to the formation of the clots now described. But these clots, at this stage of the process, are necessarily very soft, as well as very imperfectly adherent; and hence, in order to guard against their detachment, or, what is tantamount to the same thing, against a recurrence of the hemorrhage, it is imperative that plastic matter should speedily be effused, so that all these parts, clots, vessel, and surrounding structures, may become effectually and permanently soldered together. This accordingly soon happens; for within a few hours after the occurrence of the injury inflammation is enkindled, both in the divided artery and its sheath, and this being followed by a deposit of lymph, the parts in question are more firmly fixed in their respective situations, every day adding to their security and stability. Meanwhile, a process of organization is instituted, the first step of which is the removal of the serous and coloring matters of the clots, thereby rendering them more solid and pale; vessels now show themselves, some of them being probably of new formation, while others, and perhaps the greater number, are derived from the divided artery and its sheath, as well as from the surrounding structures.

Fig. 202.

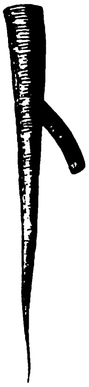


Plan of natural hemostatics, in a cut artery. At *a*, the cut end of the arterial tube; conical, by contraction. At *b*, the arterial sheath, vacated by the retracted artery, and occupied by coagulated blood. At *c*, the coagulum projecting from the orifice of the sheath.

The two clots now described are, it will be seen, inseparably blended at the orifice of the divided vessel, and their form and arrangement may not be inaptly compared to a glass stopper, closely fitted into the neck of a decanter. The outer clot is rough and irregular, whereas the internal is perfectly smooth and cylindrical, except its cardiac extremity, which is nearly always conical, as in fig. 202. The longer the internal coagulum is the less danger is there generally of its premature detachment.

The changes above mentioned as occurring in the two clots are generally the work of time; the gluing process is usually effected rapidly, since its intention is to protect the patient against hemorrhage; but the removal of the serum and coloring matter of the blood, and the conversion of this fluid into solid matter, take place more slowly, and are often not completed under several months. Finally, if the parts be examined at a still later period, it will be found that both clots have entirely disappeared, and that the injured vessel, as high up as the first large collateral branch, has been transformed into a dense, strong, fibrous cord, fig. 203, similar to that observed in the umbilical arteries of the infant.

Fig. 203.



Change in the shape and structure of an artery after ligation.

Such, then, is the process which nature employs for the purpose of arresting the flow of blood from a divided artery. Taking advantage of the exhausted condition of the system consequent upon the injury and loss of blood, she instinctively forms the two clots, having, first of all, drawn away the vessel from the main wound, as well as caused it to diminish its caliber, and then she goes deliberately to work to fasten these clots just precisely where they are most needed for the purpose. The vessel being thus hermetically sealed, she afterwards busies herself still further in getting rid of these plugs, seeing that they are no longer required, and, finally, completes the labor by converting the now obsolete extremity of the artery into an analogous tissue. These changes, which are both profoundly curious and interesting, bear, it will be perceived, a very close resemblance to those which take place in the callus of a broken bone.

After the ligation of an artery, the supply of blood in the parts beyond the seat of the obstruction is maintained by what is called the collateral circulation, the vessel above communicating freely with that below, as in fig. 204, by its anastomosing branches.

Fig. 204.

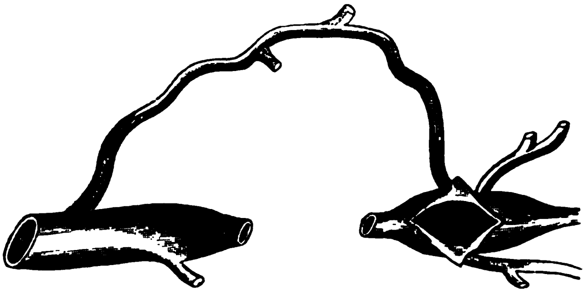


Diagram of collateral circulation.

When an artery is divided only partially, whether transversely, obliquely, or longitudinally, an external clot forms, but this is generally so imperfect as to render it altogether incompetent to offer anything like an effectual barrier to the flow of blood. What adds to the difficulty of the case is that the edges of the wound have a constant disposition to gape; and hence, although plastic matter may perhaps be deposited in great abundance, yet it is impossible for the parts to contract permanent and satisfactory adhesions to each other. Whenever the circulation is conducted with any degree of vigor, the blood as it sweeps along washes off the clot, and appears upon the exterior of the wound; and thus the hemorrhage usually continues, paroxysm after paroxysm recurring in more or less rapid succession, until it proves fatal.

Although such is the course which the case usually pursues when an artery is divided only in a part of its diameter, yet it must not be thence inferred that a very small lesion of this kind may not occasionally be susceptible of spontaneous cure. Such an event, which must, however, at best, be extremely rare, may be supposed to be most likely to occur when the wound is oblique or longitudinal; when the opening in the overlying parts is a mere fissure or canal, offering an imperfect outlet to the contents of the vessel; when the system remains for a long time in a prostrate condition; and when, finally, there is a rapid and abundant deposit of plastic matter in the various structures involved in the injury. I have several times seen small shot wounds of the larger arteries, as the subclavian and femoral, healed in this manner; and there is reason to believe that punctures made accidentally in the brachial, in bleeding at the bend of the arm, are occasionally repaired either by the direct adhesion of their edges, or through the intervention of an external clot. In general, however, all such injuries are followed either by hemorrhage, or aneurism, according to the opportunity, or otherwise, which the blood may have to find its way to the surface.

It is well known that contused and lacerated wounds of the arteries bleed much less freely than incised. The reason of this has already been explained in the chapter on wounds, and need not, therefore, be reproduced here.

But, although nature may, and, indeed, sometimes does, arrest the hemorrhage from a divided artery, yet no sensible surgeon would intrust her with such an office, when it is in his power to get at the seat of the wound; for it is hardly possible to conceive of a case involving one of the larger trunks where her efforts would be likely to be successful, or where, if ultimately triumphant, the patient would not be brought repeatedly to death's door before she could attain her end. It is only in wounds of the internal arteries, as those of the chest and abdomen, and in the aorta and its larger branches, that we must refrain from direct interference, and limit ourselves to the use of general means calculated to keep down vascular action, especially the liberal use of anodynes and sedatives, as opium, aconite, and acetate of lead, the application of ice over the seat of the injury, exposure of the body to cold air, and perfect quietude, both of mind and body. All active exertion must for a long time be avoided, in order that, if a cure should take place, the wound may not be suddenly reopened by the giving way of its edges, in consequence of the imperfect organization of the clots and plasma.

The means employed by art for suppressing hemorrhage are quite numerous, as well as quite diversified in their nature, and will therefore require to be considered somewhat in detail. The most important of these means are: first, the ligature; secondly, compression; thirdly, styptics; and fourthly, torsion. Besides these there are several others of a subordinate character, and upon which, consequently, we shall bestow merely a passing notice.

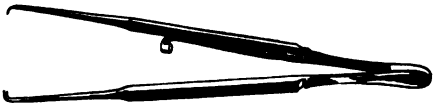
1. *Ligature.*—Ligatures are composed of various materials, as silk, linen, and soft leather. Of these, the first is the most unexceptionable, and almost the only one now employed by experienced surgeons. It should be round, smooth, well twisted, colorless, and so strong as not to break without considerable effort. For the smaller arteries, as the radial, tibial, and temporal, common sewing silk is well adapted; but for the larger trunks, as the femoral, iliac, and carotid, stay silk, which is a much stouter article, is required. Some practitioners are in the habit of using what is called dentist's silk, no matter what may be the size of the vessel, on the ground that it is much stronger in proportion to its thickness than any other similar substance, and, therefore,

less liable to excite undue irritation. This thread, which is employed in making fishing lines, is rendered very hard and stiff by means of gum, which, however, is easily removed by boiling it for a few minutes in a slightly alkaline solution. Treated in this way, a piece long enough to tie the iliac artery will hardly weigh the twenty-fifth of a grain. I have not had occasion to use this form of silk, having always had reason to be satisfied with the common article. Linen thread makes an excellent ligature; and in case of emergency, a sensible surgeon will not hesitate to take anything that may happen to come in his way. Whatever substance be employed, it is very important that it should be thoroughly waxed, otherwise it will be difficult, if not impracticable, to draw and tie it with the requisite degree of firmness, to say nothing of the greater tendency of the knot to slip. From eight to ten inches is a good average length for a ligature.

Animal ligatures were first introduced to the notice of the profession by Dr. Physick, early in the present century, and they have ever since been occasionally employed by different practitioners, chiefly American. The late Dr. Jameson, of Baltimore, used them nearly altogether for many years, under the belief, founded upon numerous experiments and clinical observations, that they were decidedly superior to all others, their presence never causing any of the irritation which sometimes follows the use of the ordinary substances. The article to which he gave the preference was soft buckskin leather, which he cut into thin, narrow strings, care being taken not to tie them too firmly, lest they should break, and be prematurely detached. Other practitioners have recommended the fibres of the sinew of the deer. The advantage of the animal ligature is that, besides approaching more nearly to the living tissues than any other material, the ends may be cut off close to the knot; its disadvantage, that it soon becomes disintegrated, from the imbibition of the fluids, thereby rendering it liable to separation before it has accomplished the object for which it was applied. This reason is, I conceive, quite sufficient to induce its rejection from practice; for no conscientious surgeon, it seems to me, would ever subject his patient to such a contingency, especially when he has always at hand so reliable a substance as silk.

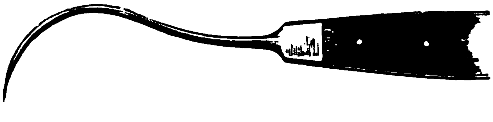
The wounded artery may be very conveniently drawn out with a pair of spring forceps, seen in fig. 205, an instrument which, indeed, I generally prefer, or with a tenaculum, represented in fig. 206. If the vessel be small, it should be seized in its longitudinal axis, but in the horizontal if it be large, since in this way we can more effectually occlude its orifice, and thus prevent the loss of blood. It is for this reason, also, that the forceps are generally to be preferred to the tenaculum; the latter instrument, however, possesses

Fig. 205.



The spring artery-forceps.

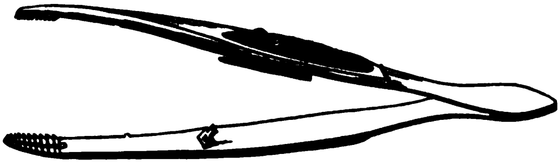
Fig. 206.



Tenaculum.

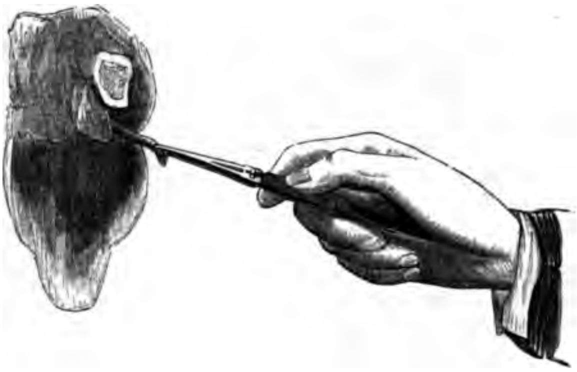
an advantage over the former when the artery is cut off very closely, or when it is desired to include some of the surrounding tissues. Care must be taken not to transfix the coats of the vessel, and then tie the ligature below the point of perforation, as this might lead to secondary hemorrhage. When no good assistant is at hand, the artery forceps, represented in fig. 207, an instrument with broad, serrated extremities, and a movable slide or catch, to close the blades, will be found convenient. The vessel being pulled gently out, as in fig. 208, is carefully isolated from its connections, either with another pair of forceps, the finger, or the knife, or all three together, as may be most expedient. The propriety of excluding from the ligature the smallest nervous filament, as well as the most insignificant vein, and every particle of muscular tissue, must be obvious to the merest tyro, and need not therefore be expatiated upon here. Such a procedure would not only be productive of pain, but would be liable to be followed by suppurative action, and perhaps materially impede the separation of the thread. The ligature is placed immediately above the point of the instrument, whether this be the forceps or tenaculum, and being tied in a single knot, is drawn with sufficient firmness to divide the inner and middle tunics, as in fig. 209, if the artery be one of large size, or even of medium caliber; while in the smaller branches, mere apposition of the opposite surfaces will suffice. In executing this part of the operation, the extremities of the ligature are to be drawn round the fore and middle fingers of each hand, while the thumb is extended upon them nearly as far over as the vessel, in order that the force may be exerted in as gentle and equable a

Fig. 207.



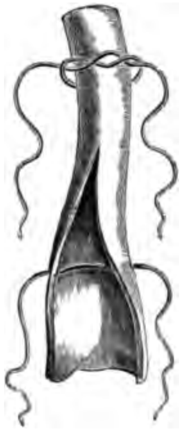
Sliding-forceps.

Fig. 208.



Mode of drawing out and isolating an artery.

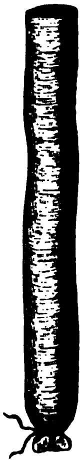
Fig. 209.



Effects of ligation upon the inner coats of the artery.

manner as possible. Nothing is more unseemly, or more truly abominable, than to see a surgeon or his assistant pull a ligature by fits and jerks, or so violently as to break it in pieces, or, perhaps, lacerate and tear off the artery itself. With a little care and gentleness, a comparatively weak ligature may be thrown round a vessel so as to answer the intention most fully. I deem it my duty to dwell upon this point with some degree of emphasis, because it has happened to me to witness quite an unusual number of these Herculean feats with the ligature, the men often pulling as if they had hold of a rope and piece of wood, instead of a delicate thread and artery. Fig. 210 shows the indented appearance of the artery after ligation.

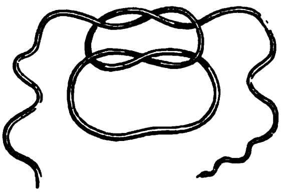
Fig. 210.



Exterior of an artery after ligation.

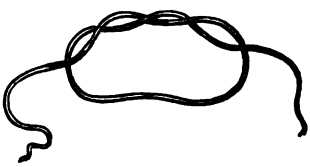
The ligation is completed by making a double knot, when one end is cut off close, and the other is afterwards brought out at the nearest angle of the wound. The knot which is thus made is the reef-knot, fig. 211, in which the ends of the thread lie across the artery, in the same manner as in the lips of the wound in the ordinary interrupted suture. The surgeon's knot, fig. 212, is no longer used for the purpose, as, from the manner of making it, it is very irregular, and, consequently, ill adapted to the object. In tying very small vessels, we sometimes use only one knot.

Fig. 211.



Reef-knot.

Fig. 212.



Surgeon's knot.

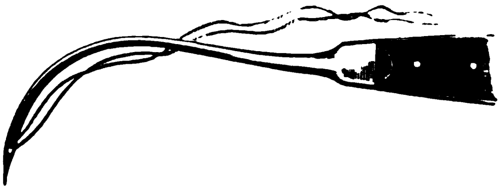
The practice of cutting off both ends of the ligature, and of closing the wound over the injured vessel, first suggested towards the latter part of the last century, by Mr. Haire, of England, and afterwards so warmly lauded by Mr. Lawrence and Mr. Hennen, is now, I believe, universally abandoned, and very justly so, on the ground that the noose, after having performed its duty, creates irritation among the parts with which it lies in contact, leading thus to the development of abscesses, which continue to discharge as long as the foreign substance remains. When the animal ligature is used, this objection does not obtain, as the noose is soon removed by absorption; but then, as was previously observed, this material ought not to be employed, because of its liability to give way before the vessel is completely occluded.

When the arteries are diseased, or abnormally brittle, in consequence of the fibrous, cartilaginous, earthy, or fatty degeneration of their tunics, the ordinary ligature must be dispensed with, and a flat one used in its stead. It may consist of two or more silk threads, carefully waxed, and arranged side by side, or of a piece of soft, narrow braid, and should be drawn so gently around the artery as merely to approximate its serous surfaces. In using the round ligature the object is to divide the inner and middle tunics, as this is most favorable to adhesion; but in this case we aim to preserve their integrity, well knowing that if this be not done the ligature will fall off prematurely, and thus lead to secondary hemorrhage. Cases occur in which the fragility of the arteries is so great as to render them incapable of bearing even this degree of pressure; under such circumstances our only resource is to surround the vessel with a portion of muscular or aponeurotic substance, and to include the mass in a flat ligature. Such a procedure is much more scientific than the practice, formerly recommended, of tying the artery over a roll of adhesive plaster, an operation which cannot fail to be followed by mischief.

In regard to the propriety of drawing the ligature so firmly as to divide the inner and middle tunics, no doubt is any longer entertained by enlightened practitioners. In the time of Scarpa much disputation prevailed respecting this point in the ligation of arteries, it having been alleged by this distinguished surgeon, on the strength of numerous experiments, that a cure could be effected quite as rapidly, and, in the end, more safely, simply by placing the serous surfaces gently in contact with each other. It was supposed that the part, treated in this way, would unite by direct adhesion, and that, consequently, when the ligature finally became detached, there would be much less risk of hemorrhage than when the vessel is lacerated and contused by the ruder method of procedure above described. Plausible as this theory may, at first sight, appear, it is found to be wholly unreliable in practice, for the very reason which induced Scarpa and his followers to advocate its adoption, the ligature being not only a much longer time in separating, but the two ends of the artery being much less effectually occluded. When it is recollected that a certain degree of inflammation is necessary, after this operation, in order to afford the requisite amount of plasma, for gluing the inner clot to the surface of the vessel, it is reasonable to suppose that it would be much more easily induced by a partial division of the inner and middle tunics than by the mere approximation of the opposite sides of the tube; and this is precisely what the general experience of the profession has at length established in relation to the subject.

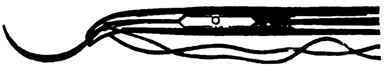
When a considerable portion of neighboring tissue is obliged to be included along with the artery, the best instrument for performing the operation is a sharp tenaculum, with an eye near its point, as seen in fig. 213; a curved needle armed with a ligature; or Physick's artery-forceps, fig. 214.

Fig. 213.



Tenaculum-needle, armed with a ligature.

Fig. 214.

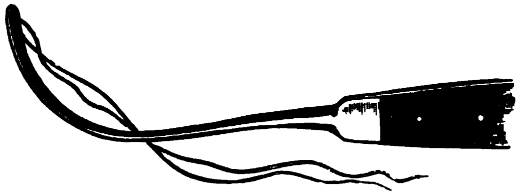


Physick's artery forceps.

An artery is sometimes rendered incapable of bearing the ligature in consequence of the softening of its tunics by inflammation. Such an event, which is often exceedingly perplexing, is most liable to happen in cases of secondary hemorrhage after wounds and amputations. The remedy is to isolate the vessel a short distance beyond its diseased limits, and to ligate it there in the usual manner; or, this being impracticable, to tie the diseased part along with more or less of the surrounding tissues; or, this also failing, to cut down upon and secure the main trunk of the artery.

In tying an artery in its continuity, whether as a means of arresting hemorrhage, or of curing disease, the ligature is passed around the vessel by means of an aneurism-needle, fig. 215, a kind of blunt tenaculum, with an eye at the free extremity. Special care must be taken, in performing the operation, to disturb the sheath of the artery as little as possible; this structure is intimately connected with the nutrient vessels, and hence the less it is interfered with the less likely will the artery be to soften, ulcerate, or mortify. There is another point of deep interest connected with this operation, and that is the application of two ligatures, with the section of the vessels between them. This operation, which dates as far back as the time of Aetius, was revived by Mr. Abernethy, through whose influence it became for a while quite popular. It was soon found, however, that it was liable to be followed by secondary hemorrhage, owing chiefly to the injury inflicted during its execution, and it has therefore deservedly fallen into desuetude.

Fig. 215.



Aneurism-needle, armed with a ligature.

It was also in the Aetian operation that some of the surgeons of the last century employed what was termed the *reserve ligature*, intended as a ready resource in sudden emergencies. The cord was placed loosely around the artery, to be tied instantly in the event of hemorrhage, from the premature detachment of the original ligature. Experience, however, which is the only true test in such cases, soon showed that the procedure, instead of answering the design for which it had been intended, had a direct tendency to bring about the mischief, from its liability to produce ulceration of the denuded and tortured vessel. Its evils, indeed, are so palpable that it is extremely probable that it will never be revived by any enlightened surgeon.

When an artery is cut completely across in the continuity of a limb, as, for instance, in a sabre wound of the femoral, it is necessary to use two ligatures, one for the cardiac, and the other for the distal extremity of the vessel. The reason of this is that, however securely the cardiac end may be tied, there will inevitably be more or less hemorrhage from the lower end, unless this be tied also, in consequence of the activity of the recurrent circulation. Every one who has ever had occasion to ligate the brachial artery at the bend of the arm, on account of injury inflicted upon the vessel in bleeding, must have seen that the hemorrhage was only partially controlled by ligating the upper extremity. The blood, under such circumstances, wells up from the lower part of the artery as water bubbles up from the bottom of a spring; it does not issue in jets, or in a saltatory manner, as when it proceeds from the upper orifice, but lazily, and of a dark color, the bleeding resembling that of a vein rather than that of an artery; and thus the hemorrhage goes on, with little or no interruption, until it is arrested by ligature, or until it proves fatal. The flow may, it is true, be temporarily stopped, during an attack of syncope; but even then seldom perfectly, for the reason, apparently, that the vessel here does not possess the same power of contraction and retraction that it does above, and that, therefore, it is not capable of forming any efficient clot, either external or internal.

The changes which occur in an artery after the application of the ligature are essentially similar to those which occur when the bleeding is arrested spontaneously. The first thing that happens, after such an operation, is the coagulation of the blood within the artery as high up, generally, as the first considerable collateral branch, thus forming what is named the internal clot. The external clot is of course wanting, and this circumstance constitutes the chief point of difference in the two cases. The injured tunics, becoming inflamed, pour out plasma into their own substance, and also upon the free surface of the serous membrane, by which the internal clot becomes firmly and permanently fixed in its situation; the clot next becomes organized, and finally, after an indefinite period, it is completely removed by absorption, the corresponding portion of the artery being converted into a dense, fibro-ligamentous cord.

The changes experienced by the arteries and the blood in their interior, after the application of the ligature, are admirably illustrated in the adjoining sketches. Fig. 216 represents the carotid artery of a dog 48 hours after deligation. At *a* the coats are cut across; lymph is effused around, and a clot is formed on each side of the ligature. Fig. 217 exhibits the artery 96 hours after the operation. The extremities of the vessel are surrounded by

Fig. 216.

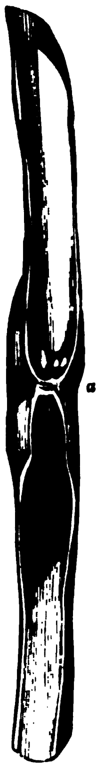


Fig. 217.

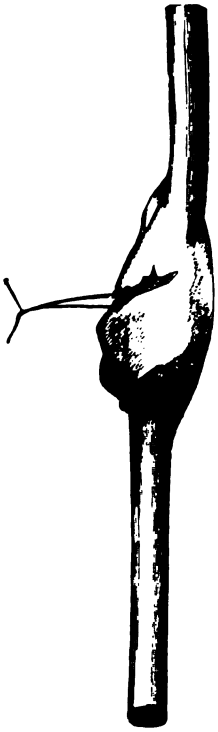
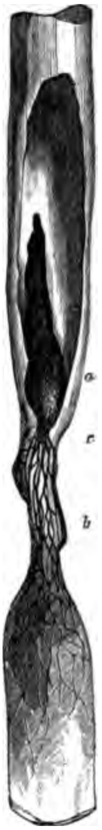


Fig. 218.



a mass of plasma, through which the ends of the ligature are seen protruding. Fig. 218 represents the vessel on the twelfth day after the deligation. At *a* the artery is cut open, to show its interior; at *b* numerous vessels are seen coming from the exterior, and coursing onwards to enter the clot at *c*.

The period at which the ligature is detached varies with many circumstances, of which the principal are, the size of the cord and the manner in which it has been tied, the state of the artery, and the amount of the resulting inflammation. A small ligature will, other things being equal, be detached sooner than a large one, and a firm sooner than a loose one; a sound artery will be longer in throwing it off than a diseased one, simply because it has more power of resistance. A ligature upon the brachial artery will generally be detached in about ten days; upon the femoral, in from twelve to fourteen; upon the external iliac, in sixteen; and upon the common iliac, in about twenty-one days. To this rule there are, of course, many exceptions. I recollect the case of a man in the Louisville Marine Hospital, in whom, after an amputation of the leg, the ligature was still firmly adherent to the anterior tibial artery at the end of the fourth month. Dr. Lopez, of Mobile, communicated to me, some years ago, the particulars of a case where the separation was not effected before the end of the eleventh month; and Professor Eve met with one where it did not occur until after the thirteenth month. Such cases constitute, of course, exceptions to the general rule, and it may be fairly assumed that they usually depend either upon the faulty manner in which the operation is performed, or upon the presence of an extraordinary quantity of organized plastic matter, interfering mechanically with the detachment of the thread.

When the ligature is indisposed to come away, gentle traction may be made upon it, repeated once in the twenty-four hours; great care, however, must be exercised in performing the operation, otherwise we may not only inflict severe pain upon the patient, but subject him to the risk of secondary hemorrhage.

The process by which the separation of the ligature is effected is worthy of inquiry. It is generally ascribed to ulcerative action, and this is undoubtedly true; but it is equally true that that portion of the artery immediately embraced by the ligature mortifies, and comes away in the form of a slough. When the cord is drawn very tight, the corresponding part of the artery is strangulated, either at once, or, at any rate, in a few hours; but, in general, the process takes place more tardily, and thus affords the two ends of the vessel time to prepare and fortify themselves for the approaching crisis. If we study the whole subject minutely, it will be found to embrace the following acts: first, the strangulation and death of the vessel at the site of the ligature; secondly, ulceration and the consequent separation of a part of the artery, thus producing a gap in its continuity; thirdly, the adhesion of the clot to the inner surface of the vessel, speedily followed by its organization; and lastly, the absorption of the clot and the transformation of each extremity of the tube into a dense fibrous cord. In addition to these changes, there is occasionally slight suppuration, the matter usually presenting itself in the form of a little abscess.

The discovery of the use of the ligature is due to Ambrose Paré, in the sixteenth century, prior to whose time surgeons were in the habit of stanching hemorrhage with the actual cautery, hot pitch, and all sorts of styptics, of the most cruel and barbarous nature. "For the good of mankind," says this great man, "and the improvement and honor of surgery, I was inspired by God with this good thought." Paré himself fully appreciated the utility of his invention, but his cotemporaries spared no pains to undervalue it, and to revile and persecute its author, subjecting him to the humiliating office of searching the writings of the ancient fathers of medicine for traces of the use of the ligature as a justification of his practice. Gourmelen, the jealous and malignant President of the College of Physicians of Paris, made himself particularly conspicuous on the occasion, and thus earned an infamous reputation; for the only act by which he is now remembered is his bitter and unrelenting persecution of Paré, rendered immortal by his great achievements.

2. *Acupressure.*—The credit of devising acupressure, as a means of arresting hemorrhage, is due to Professor Simpson, who published an account of it in the Edinburgh Medical Journal for January, 1860. Since that period the operation has attracted much attention, having been performed by different surgeons both in Europe and this country with results generally of a highly gratifying character. What its ultimate fate may be, however, time alone can determine. That it is destined entirely to supersede the use of the ligature is not at all likely; on the contrary, indeed, highly improbable, inasmuch as the instrument with which the pressure is made can be applied only in certain regions of the body.

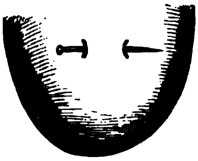
The advantages claimed for this operation over that of the ligature are, first, that it is more easy, simple, and expeditious of execution; secondly, that the acupressure needle does not, like the ligature, provoke irritation, much less suppuration, ulceration, or mortification at the seat of the constriction; thirdly, that the instrument may generally be removed, even when a large sized artery, as, for example, the femoral, is concerned, at the end of the second or third day; fourthly, that the wound will, other things being equal, be more liable to unite by the first intention; and, lastly, that there will be much less risk of the occurrence of erysipelas, pyemia, phlebitis, abscesses, traumatic fever, and secondary hemorrhage.

The only instrument required for this operation is a steel pin, sharp at one end and provided at the other with a glass-head, of a rounded shape, sufficiently stiff to prevent it from bending, perfectly smooth, and coated with silver, zinc, or gold, although this is not at all essential. The length of the pin should vary, according to the caliber of the vessel and the diameter of the limb in which it is situated, from two and a half to six inches. In ordinary cases the lady's bonnet pin, or the pin worn by gentlemen in their shawls, will answer every purpose. In regard to the isolation of the artery from the surrounding structures, the same rules are applicable as in the use of the ligature. There is, however, less danger from the inclusion of the accompanying veins, and hence these vessels may with great propriety be embraced along with the artery in the event of their being disposed to bleed unduly, as they occasionally are in amputations, resections, and the extirpation of large tumors.

In performing the operation, the pin, previously oiled, is passed from without inwards through the skin and thence on through the muscles and other structures down to and underneath the artery, in such a manner as to obliterate completely its caliber by bringing together its opposite surfaces. The instrument is then pushed through the tissues on the other side from within outwards, so that, when the transmission is effected, the extremities shall rest upon the skin, while the middle shall firmly embrace the artery. Should the constriction not be sufficient to arrest the flow of blood, a ligature may be thrown tightly around the pin as in the operation for hare-lip; but this will seldom be necessary, especially if the precaution be taken of inserting the compressor close to the vessel, or at a rather acute angle. The point of compression for the larger vessels should be at least six lines from the open orifice, and about half that distance for those of smaller size. The pin should be left entirely free during the application of the dressings, and in withdrawing it the parts must be well supported in order to avoid the risk of hemorrhage.

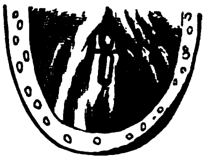
The annexed sketches, from Erichsen, will serve to show, at a glance, the application of acupressure. Fig. 219 exhibits the extremities of the pin as they project through the skin, while fig. 220 displays the manner in which the instrument embraces and constricts the artery. A good idea of it may also be formed by the manner in which the stalk of a flower is fastened to the lapel of a coat by transfixing the cloth with a pin.

Fig. 219.



Acupressure, showing the manner in which the ends of the pin project across the skin.

Fig. 220.

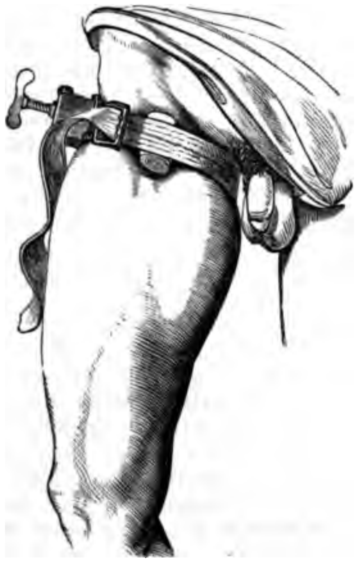


Position of the artery and pin in acupressure.

3. *Compression.*—Although the ligature is the most certain means of arresting hemorrhage, yet cases occur to which it is either not at all adapted, or where, from the great depth and narrowness of the wound, it is impracticable to apply it. It is under such circumstances that compression becomes available; an agent which is often hardly less valuable than ligation itself. It is particularly serviceable when the injured vessel lies upon a bone, as in wounds of the brachial and temporal arteries; in wounds penetrating deep cavities, as the thoracic and abdominal; and, lastly, when the blood issues from a considerable number of small vessels instead of from one large one.

The compression may be temporary or permanent, according to the exigencies of each particular case. When temporary, it is made with the hand, finger, tourniquet, or compress and bandage, and is only kept up until the injured artery can be ligated, or secured in some other effectual way. In permanent compression, the application is continued until the vessel is completely obliterated, whether the time be short or long.

Fig. 221.

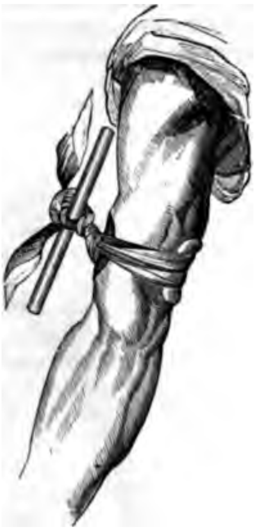


Tourniquet applied to the femoral artery.

Temporary compression becomes necessary chiefly in cases of sudden emergency, as, for example, when an individual is stabbed in the femoral artery, and the surgeon cannot obtain any persons to assist him in tying the vessel. Under such circumstances an attempt is made to arrest the hemorrhage by means of the tourniquet, shown in fig. 221, or by a graduated compress and bandage; the former being placed directly over the course of the artery from which the bleeding proceeds, or, if this be impracticable, over the main trunk of the limb, and the latter directly over the wound as well as for some distance above it, along the track of the vessel. Whichever method be adopted, it is to be borne in mind that the compression, even if it be maintained only for a few hours, may become a source not only of excessive pain, but also of mortification, and that, therefore, the greatest possible vigilance should be exercised in its employment.

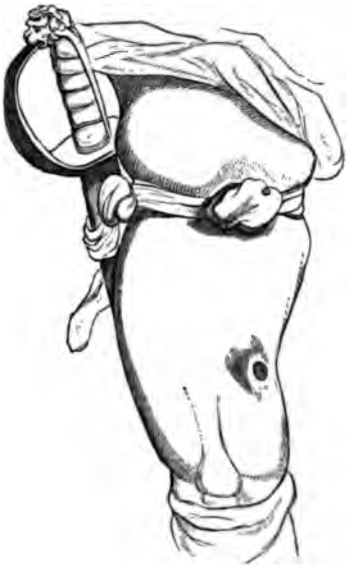
When the ordinary tourniquet is not at hand, very efficient compression may generally be made by tying a piece of bandage, a cravat, or a handkerchief loosely round the limb, and then twisting it to the requisite extent by means of a stick, fig. 222, or the hilt of a sword, fig. 223, inserted underneath it. This contrivance, usually called the field-tourniquet, because it was originally employed on the field of battle, may be resorted to with great advantage when a surgeon is obliged to amputate an extremity without having a sufficient number of intelligent assistants, although it labors under the inconvenience of not always concentrating the pressure upon the spot where it is most needed. For this reason the common tourniquet is always to be preferred.

Fig. 222.



Field tourniquet; handkerchief and stick.

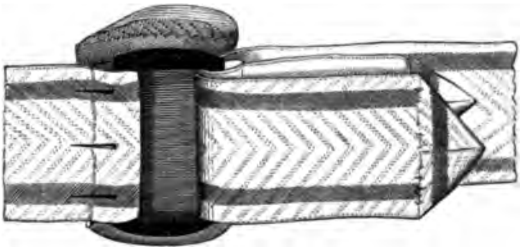
Fig. 223.



Field tourniquet; handkerchief and sword.

A very simple and effective tourniquet for field practice was recently introduced by Mr. Tiemann into this country from Prussia, where it is extensively used in the military service, every orderly sergeant being required to carry one in his pocket for ready use. It simply consists, as will be seen in fig. 224, of an oblong square brass ring and of a strong strap, the latter of which,

Fig. 224.

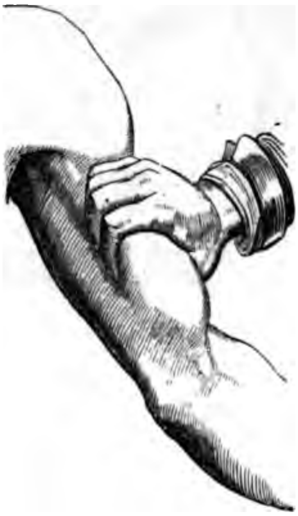


Prussian field tourniquet.

after having encircled the limb, is passed through the former and secured to the hooks attached to one of its margins. The instrument has no pad.

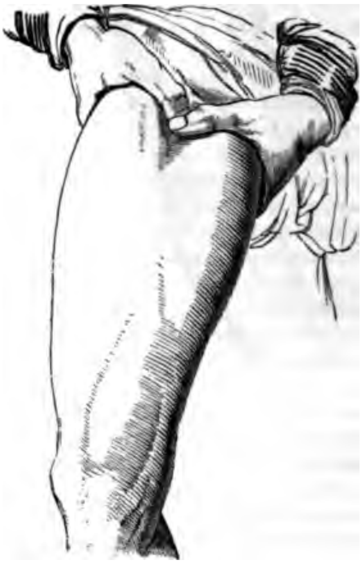
Compression with the hand may often be advantageously employed for the arrest of accidental hemorrhage, until the surgeon has time to apply the ligature; and it is also occasionally resorted to for the purpose of controlling the circulation in the main artery of a limb during amputation. In the upper extremity it is generally applied to the brachial artery, as it courses along the inner border of the flexor muscle; and in the lower, to the femoral artery as this vessel issues beneath Poupart's ligament, and where, consequently, it lies upon the pubic bone. The annexed drawings, fig. 225 and fig. 226, are illustrative of the subject.

Fig. 225.



Digital compression of the humeral artery.

Fig. 226.



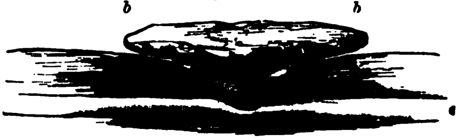
Digital compression of the femoral artery.

In *permanent compression*, the force is applied in one of two ways, that is, either directly or indirectly. The former method is particularly adapted to the suppression of hemorrhage from deep wounds, as in the lateral operation for stone in the bladder; in wounds of the rectum, whether accidental or wilful; in bleeding of the nose and uterus; in the removal of tumors from the maxillary sinus; in the extraction of teeth; in the extirpation of the eye, and, finally, in wounds of the middle artery of the dura mater, as well as in a number of other injuries and operations which will readily suggest themselves to the mind of the reader.

The great objection to this mode of compression is, first, that it is frequently very difficult to prevent it from becoming deranged, and secondly, that it is liable to produce severe pain and inflammation, the latter being generally sufficient to cause profuse suppuration. It should, therefore, I conceive, never be employed with a view of arresting hemorrhage from a large artery, or even from a small deep-seated one, if it be at all practicable to apply the ligature, which is, of course, always the most certain and efficient method; but this objection does not obtain when the blood proceeds from a bleeding cavity, or when it oozes from the bottom of a recent wound. Indeed, in such a case, compression must be used at all hazards, for there is often no other way by which the flow can be arrested.

The compression may be made with a graduated compress and roller, or by means of sponge, cotton, wool, patent lint, or any other porous substance. Whatever article be employed, the bleeding surface must be previously freed from coagula, so as to enable us to place the compress directly in contact with the orifices of the vessel, as exhibited in fig. 227. When the blood proceeds from a large artery, the circulation must be controlled, during this part of the proceeding, by means of the finger or tourniquet applied some distance above the wound. The compress is then to be thrust gently but firmly into the breach, the smallest piece being placed directly upon the orifice of the vessel, the next above this, and so on until a sufficient number have been applied, when the operation is completed by bandaging the limb from its distal extremity upwards, care being taken that the compression be made in as equable and uniform a manner as possible. The part is then put at rest, in an elevated position, and action moderated by the use of cold water, anodynes, and other suitable means. The dressings are frequently examined, but not disturbed under four or five days, unless they become displaced, or offensive from the discharges.

Fig. 227.



Plan of a graduated compress. *a*. The artery wounded. *b*, *b*. The graduated compress, arranged so that the apex of the cone is in immediate contact with the arterial orifice, while its mass occupies the general wound, and projects somewhat above the integumental level.

When the hemorrhage proceeds from a wound, as, for example, from that made in the lateral operation of lithotomy, the part must be plugged with a sponge, or piece of patent lint, the hollow of which is filled up with similar matter, or raw cotton, an instrument having been previously introduced through the foreign substance for the purpose of conducting off the urine. A like plan is pursued in bleeding of the rectum. In hemorrhage of the uterus, the vagina is plugged, while in epistaxis both nostrils are closed.

In injuries of the bones, we are sometimes obliged to use a plug of soft wood, as a piece of shingle. In compound fracture of the skull, attended with lesion of the middle meningeal artery, running in an osseous canal, such an expedient is often the only one which can be successfully opposed to the hemorrhage. Bleeding of the nutrient artery of the long bones has sometimes to be stopped in a similar manner.

In some cases the tissues of the part whence the hemorrhage proceeds are employed as the compressing agents. In the operation for hare-lip, for example, the simple approximation of the edges of the fissure by the twisted suture effectually arrests the flow of blood from the coronary artery.

The compression is said to be indirect or lateral, when it is applied to the track of the injured vessel, and not to its orifice. It is, in general, a more eligible way of arresting hemorrhage, being free from the objections that have been urged against direct compression, with which, however, it is occasionally combined. The best mode of effecting it is to place a long and rather narrow compress over the course of the artery, extending from the neighborhood of the wound some distance above, and to confine it by means of a roller, commencing at the distal portion of the limb, and carried upwards in such a manner as to afford equable support at every point. In other respects, the treatment is to be conducted as in direct compression. This mode of management is often employed, with the happiest effects, in wounds of the brachial artery, at the bend of the arm, caused by venesection.

4. *Styptics.*—Styptics are remedies which arrest hemorrhage by their direct influence upon the blood, and the arteries furnishing it. They comprise a long and varied catalogue of articles, some of which produce merely an astringent effect; others act apparently mechanically, and others, again, are escharotic, destroying both the vessels and the connecting tissues.

Among the less objectionable styptics are alum, sulphate of copper, and the perchloride of iron, especially the first, which I prefer to every other, when such an agent is called for, and which may be used either in strong solution, or in powder, through the medium of patent lint, applied directly to the bleeding surface, previously freed of coagula. Employed in this manner, it generally produces a powerful astringent effect, causing coagulation of the blood, and marked contraction of the vessels, without necessarily leading to suppuration of the affected structures, which is always the case with most of the other articles of this class. Sulphate of copper may be used in the same manner, or in the form of a stick, held firmly for some minutes upon the oozing surface. Creasote possesses none of the styptic properties which were ascribed to it twenty-five years ago, and is now seldom employed with such a view. The *perchloride of iron* possesses great coagulating powers, but the misfortune is that it creates so much irritation as inevitably to give rise to suppurative inflammation, if not to destruction of the tissues. A similar remark is applicable to the tincture of the chloride of iron. Of matico, I have not made sufficient trial to enable me to form a correct opinion as to its styptic virtues. Judging from what has been said of it by others, we must conclude that it possesses more than ordinary properties of this kind, although further observation is necessary before we can come to a final decision about it.

Within the last few years, the *persulphate of iron* has been highly recommended as a styptic by Mons. Monsel, a pharmaceutist of Bordeaux. It is applied either in substance, or, what is preferable, in strong solution, and possesses the property of instantaneously coagulating the blood, converting it into a very large, dense clot, which is absolutely insoluble, and which continues to increase and harden for several hours afterwards. What adds greatly to the value of this remedy, is the fact that it is entirely free from causticity. It is particularly adapted to hemorrhage of the nose, mouth, and throat, as well as of other parts of the body where it is impossible to ligate the injured vessels, on account of the great depth at which they are situated. It has also been used for the cure of vascular tumors of the skin and subcutaneous cellular tissue, a solution of the persulphate being injected into them by means of a delicate syringe.

A very convenient and efficient mode of using this salt was recently introduced to the notice of surgeons by Mr. Henry Johnson, of Chester, Pennsylvania. It consists of cotton thoroughly steeped in a saturated solution of the persulphate, and then dried and rolled up for use. Previously to applying it, the wound should be well wiped, when it should be covered with a thick layer, supported by a compress and a roller.

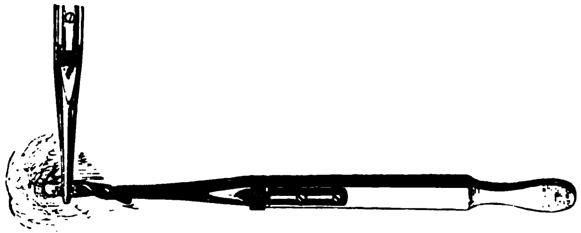
Cold is a powerful styptic, and may be used in various ways. A current of cold air will often promptly and effectually stop capillary hemorrhage, or even hemorrhage produced by the division of a small artery, as is exemplified in operations upon the tonsils and anus, or ano-rectal region, as well as upon other parts of the body. To prove beneficial, the air must have free access to the part, and it may often be usefully directed by means of the fan, which has the additional advantage of rendering it more cool.

Cold water, refrigerating lotions, pounded ice in bladders, or lumps of ice rolled up in cloths and applied to the bleeding surface, or in its immediate vicinity, occasionally promptly arrest hemorrhage. These applications are particularly valuable in deep-seated hemorrhage, or in hemorrhage of the internal organs and cavities; they must, however, be used with a certain degree of caution, as their protracted continuance may be followed by injurious reaction, and even by mortification of the part. When the wound is situated externally, but too deeply to render the injured vessels accessible to the ligature, the bleeding may often be promptly and effectually checked by a full stream of iced water, directed upon the part, and maintained steadily for some time, from a large syringe.

The *actual cautery* can hardly be considered as a genuine styptic, although it is usually classed under this head. Its effect is not to constringe the vessels, but to destroy them, by producing an eschar, by which the vessels are, for the time, hermetically sealed. Upon the separation of the slough, however, there is frequently a reproduction of the hemorrhage, especially if the wounded vessels are at all large, owing to the imperfect coagulation of their contents. The cases to which the cautery is mainly applicable are those in which the hemorrhage proceeds from a deep and narrow osseous cavity, and in wounds of the tonsils, uterus, and rectum. The instrument, which may be of a conical form, should be heated to a black or slightly red heat, and used in such a manner as not to injure the structures around the seat of the affected vessels. When the artery is very diminutive, we may sometimes attain our object with a hot knitting-needle, a wire, or probe.

5. *Torsion.*—Torsion is an old procedure, reintroduced to the notice of the profession by Thierry, Amussat, Velpeau, and others; at one time pointedly condemned, at another immeasurably lauded; opinion being still at variance, although decidedly preponderating against it. In the enthusiasm of the moment much was said and written in its favor; it was even alleged that the larger arteries might be occluded in this way, and a German surgeon, Dr. Koch, of Munich, actually published some cases of amputation of the thigh, in which he trusted entirely to torsion as a means of preventing hemorrhage. No other practitioner, however, has, I believe, had the hardihood to imitate him, and the operation is now entirely limited to the smallest arterial twigs. The proceeding, which is said to answer most admirably in the inferior animals, serving as a substitute for the ligature, is executed with two pairs of forceps, as shown in fig. 228; a small one for drawing out the artery by grasping it horizontally, and a long, stout one provided with a slide, and serrated blades, for twisting it in its longitudinal axis; from six to eight turns being required, according to the size of the vessel, to lacerate and bruise its tunics so as to intercept and coagulate its contents. I have rarely found torsion of any service even in the smallest arteries.

Fig. 228.



Torsion-forceps.

General Means.—Whatever mode of procedure be adopted for arresting the bleeding, it is an object of primary importance to place the affected part perfectly at *rest*, in an easy and elevated position; the slightest motion might be injurious, especially where no ligature has been used, and should therefore be sedulously guarded against. Repose of the body is equally necessary with that of the part, and it is hardly needful to add that mental tranquillity is also of the greatest moment. Cardiac action, too, must be maintained in the most perfect quietude, as any perturbating agency of this kind cannot fail to favor a return of the hemorrhage and exhaust the system. With a view of inducing this result a full anodyne should be administered early in the disease, the dose being repeated from time to time as occasion may seem to require the soothing and sustaining influence of the remedy. Too much stress cannot be laid upon the use of opiates in the management of arterial hemorrhage, and it is surprising that the remedy is not more generally employed than it seems to be. To allow the heart to go riot, or to move and toss about tremulously, as it is so liable to do after serious loss of blood, while we take every local precaution for the suppression of the bleeding, is assuredly a strange inconsistency, and one altogether irreconcilable with experience and common sense.

The *diet* should be perfectly bland, and just sufficient in quantity to supply the wants of the body. To give less might cause irritability of the system; to give more, over-stimulation. The drink must be cold and acidulated, and not taken so freely as to oppress the stomach, which will be sure to happen if the quantity be not carefully restricted, as the thirst is always urgent after the loss of even a comparatively small portion of blood. Lumps of ice, or pounded ice, held in the mouth, and gradually swallowed, often prove most grateful and beneficial. The air of the apartment must be kept perfectly cool; and, in short, every effort must be made to maintain the tranquillity of the circulation.

Secondary Hemorrhage.—Secondary hemorrhage occurs at variable periods; sometimes in a few hours, at other times not under several days or weeks. It is not necessarily preceded by primary hemorrhage, but may come on where the loss of blood in the first instance was perhaps altogether insignificant, and where everything, so far as this event is concerned, gave promise of a most favorable issue. The bleeding often supervenes without any assignable cause, generally suddenly and unexpectedly, and hence it often makes great progress before an opportunity is afforded to arrest it. When proceeding from a large vessel, it may prove fatal in a few minutes, in the same manner as when the bleeding is primary. The scarlet hue of the blood always denotes its source.

The causes of secondary hemorrhage are various, but the most important are the following: 1st. A faulty application of the ligature; 2d. A diseased state of the arteries; 3d. Morbid changes in the clot; 4th. Improper traction upon the ligature; 5th. Tight dressing, or too great dependency of the part; 6th. Want of retraction in the vessels; and 7th. A hemorrhagic diathesis.

1. When a ligature is properly applied it simply divides the inner and middle tunics, leaving the outer intact; this too, however, may be cut, not completely, but partially, and therefore the more insidiously, in consequence of the force used in tightening the ligature; or, the deligation may not have been sufficiently firm, the opposite surfaces being only slightly approximated, and the resulting adhesion, therefore, inadequate to effect hermetic closure of the artery on detachment of the cord; or, lastly, the fault may have existed in the ligature itself, on account of the rottenness of its substance, or the imperfect tightening of the knot. Whatever the cause may be, the proper remedy is more efficient ligation.

2. The hemorrhage may arise from disease of the *artery*, either from undue inflammation, or degeneration of its coats, rendering them incapable of supporting the ligature until the clot has contracted firm adhesions. The mode of procedure is obvious; a more healthy portion of the vessel must be sought for, and the ligation effected with more caution; or, this failing, the hemor-

rhage may be arrested by tying the main trunk of the limb, some distance from the seat of injury.

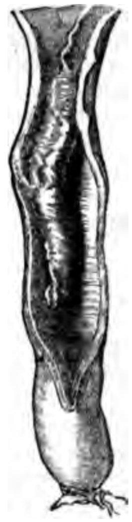
3. Morbid changes in the *clot*, commencing in a process of softening and disintegration, occasionally occur after ligation, leading to its premature detachment, perhaps several weeks after the operation. Such changes, which are well illustrated by the annexed sketch, fig. 229, from Erichsen, are most frequent in cases of pyemia and diffuse erysipelas, consequent upon some injuries and amputations, eventuating in a tendency to suppurative inflammation. The only remedy, under such circumstances, is the ligation of a healthy portion of the artery.

4. Young and inexperienced surgeons sometimes bring on hemorrhage by improper traction of the *ligature*, with a view to the promotion of its separation; forgetting that they may thus tear the artery, or, at all events, break up important adhesions. Such a procedure cannot, as stated elsewhere, be too severely censured. Re-ligation is obviously the remedy in such a case.

5. *Tight dressing*, causing unequel constriction of the part, or improper dependency, favoring undue afflux of blood, may induce this form of hemorrhage. The result will be most likely to happen when a number of small arteries have been divided, without any attempt having been made to secure them with the ligature. Bleeding having ceased, the dressings are applied, but too firmly, or the part is placed too low, and presently blood begins to appear, issuing, perhaps, with great freedom. The treatment consists in the removal and readjustment of the dressings, with strict attention to posture.

6. Secondary hemorrhage occasionally comes on after operations for the relief of anal, perineal, and other fistules, chronic abscesses, and old ulcers, from an inability of the vessels to *retract* in consequence of the indurated condition of the divided parts. Exposure of the surface to cold air, the application of ice, direct compression, or styptics, constitute the best means of relief. In some cases the actual cautery may be required.

Fig. 229.



Partial absorption of the clot, in the femoral artery, a fortnight after amputation.

7. Finally, the cause may be a *hemorrhagic diathesis*, an affection which, as will be stated elsewhere, may occur at any period of life, and which it is often found extremely difficult to control by any mode of treatment, however judiciously conducted.

SECT. II.—SUBCUTANEOUS HEMORRHAGE.

There is a form of arterial hemorrhage to which, from its situation, the term subcutaneous is very properly applicable. It takes place when, from any cause, an artery is laid freely open, and its contents, instead of escaping externally, are extensively extravasated among the surrounding structures. In ordinary hemorrhage, the blood issues directly from the injured vessel, because the outer wound is sufficiently capacious to admit of its free and unrestrained passage, and the consequence, generally, is that it continues until the patient faints, and the bleeding orifice is closed by coagula. In the variety of hemorrhage, however, under consideration, the opening in the integuments is so small as to prevent the blood from appearing externally, and it therefore accumulates beneath the skin, in the subcutaneous cellular tissue, when the artery lies superficially, or in the subcutaneous and intermuscular cellular tissue, when it is deep-seated. The accident which usually causes this hemorrhage is a puncture, such as that inflicted in venesection at the bend of the arm, where, in civil practice, it is most commonly met with. It may, however, in consequence of a stab, a bayonet wound, or the laceration occasioned by the sharp end of a broken bone, occur in any part of the body, and is sometimes most profuse, its extent being regulated chiefly by the size of the affected vessel, and the quantity and laxity of the connective substance. In the superior extremity, the extravasated fluid often reaches nearly as high up, on the one hand, as the axilla, and, on the other, as low down as the inferior third of the forearm, extensively separating the muscles from each other by breaking up their cellular connections, and forming a large, ill-shaped, and confused swelling, attended with violent pain, numbness and œdema of the whole limb, and discoloration of the integuments. More or less pulsation is generally present, especially in the earlier stages of the case, and, upon applying the ear over the site of the wound, a well-marked bruit can frequently be recognized, attended occasionally with a peculiar thrill, or a whirring noise, and a vibratory sensation. It is for these reasons that this affection has usually been described by writers as a variety of aneurism; and, as the blood is always widely extravasated, the prefix diffuse is usually added to that term, as particularly expressive of its more important attributes. Strictly speaking, however, there is no aneurism here; there is simply a subcutaneous accumulation of blood, the consequence of external injury, without any dilatation of the vessel, or degeneration of its tunics; and, although there frequently is, as just stated, more or less concomitant pulsation in the part, yet this does not any more entitle it to be regarded as an aneurism than it would if the effused fluid were so much pus or serum.

The blood which is effused in this accident usually promptly coagulates, and, exerting injurious compression upon the parts with which it is in contact, soon excites severe inflammation, which, especially in persons of an irritable constitution, is liable to assume an erysipelatous character, and to terminate in suppuration, ulceration, and even gangrene. The pain is often intense, depriving the patient of appetite and sleep, and making rapid inroads upon the system. I have witnessed cases where, from the excessive distress thus produced, hectic fever soon came on, and life was placed in imminent peril.

The *treatment* of this lesion is precisely similar to that which is necessary when there is an open wound; that is, the artery must be secured promptly and at all hazard, and the coagulated blood thoroughly evacuated. The operation is often one of great embarrassment, owing to the confused and displaced condition of the parts, and the difficulty which is sometimes experienced in finding the injured vessel, which is not unfrequently lost in the midst of the coagulated blood. A large incision is generally required, and two ligatures must be applied, one above and the other below the wound in the vessel, precisely as in ordinary cases, the object being to prevent hemorrhage by the recurrent circulation. As a preliminary step, the brachial artery is compressed in the middle of the arm by the finger or tourniquet, and after the operation is over, the limb is wrapped up in warm water-dressing, medicated with laudanum and acetate of lead, or laudanum and alcohol, to favor the reduction of inflammation.

SECT. III.—COLLATERAL CIRCULATION.

Among the more interesting phenomena that occur after the deligation of the larger arteries, not the least curious and important is the manner in which the circulation is carried on and maintained in the structures beyond the seat of the ligature. A long time elapsed after the discovery of the ligature before surgeons could be induced to believe that such an operation could be performed in the continuity of a limb without endangering the parts below by gangrene, in consequence of the sudden abstraction of their accustomed supply of blood. Chance gradually led to the correction of this apprehension, which, however, is not without some foundation, as is proved by the fact that the procedure is occasionally followed, even at the present day, in the hands of the most scientific surgeons, by loss of limb and life. Cases had been observed, from time to time, of the obliteration of the largest arterial trunks by fibrinous concretions, and yet it was perfectly certain that the structures in the distal portions of the extremity had retained their normal growth, no difference being discoverable between them and those of the opposite side. Such a result, it was obvious, could only have been brought about by an enlargement of the collateral vessels, thus enabling them to keep up the normal supply of blood, after the obstruction of the main artery. A number of instances had been noticed of complete closure of the aorta, both in its thoracic and abdominal divisions, without any apparent detriment of any kind, either proximate or remote. These facts, the fruits of the cultivation of morbid anatomy, were eminently suggestive, and we accordingly find that they gradually paved the way for some of the most daring feats in surgery. The original trials with the ligature upon the principal arteries in the continuity of the limbs were highly gratifying, as tending to show that, although the distal structures were temporarily deprived of their accustomed supply of blood, yet this occurrence did not sufficiently interfere with their vitality to cause gangrene, the circulation being speedily re-established through the collateral routes. The process employed by nature in effecting this object has been demonstrated, in repeated instances, by dissection of the parts at variable periods after they had been subjected to operation.

The moment a large artery, as, for example, the femoral, is tied, the blood is obliged to seek new channels for its transmission to the distal portion of the limb. For this purpose it passes on in every direction, entering every vessel, both large and small, into which it can find access. This, however, does not occur all at once, but gradually; for as the arteries which are to carry on this collateral circulation, as this arrangement is termed, are comparatively small, some time is necessary to prepare them for the reception and accommodation of the increased flow of blood. In fact, they are compelled to submit to a species of preliminary dilatation, their tonicity being such as rather to resent its encroachment than to yield to its effects. This is the case both with the branches that are detached from the sides of the vessel above the seat of the ligature and with the capillaries of the various tissues entering into the composition of the limb, which, immediately after such an event, always play an important part in maintaining the distal circulation. Hence, for some time after the operation, the quantity of blood below the point of obstruction is necessarily considerably less than in the normal state, as is demonstrated by the cold and pallid state of the integuments, the defective sensibility, and the loss of muscular power, which is occasionally so great as to deprive the patient of motion in the affected member. The diminution of temperature is liable to a good deal of variation, but in general it amounts to several degrees, and hence the surgeon is often obliged to employ artificial heat. Gradually, however, as the circulation increases in vigor, the temperature returns to the natural standard, and in many cases even exceeds it, owing to the enlargement and inordinate activity of the cutaneous capillaries, although such an occurrence is usually of short duration.

An instance occasionally occurs in which there is either no change of temperature at all from this cause, or where it is so very slight as to be hardly perceptible. Such a phenomenon is most apt to happen in old aneurisms, where, owing to the obstruction in the artery connected with the tumor, the anastomosing vessels have had time to become enlarged prior to the application of the ligature, so that the operation exerts little, if any influence, upon the circulation in the distal portion of the limb, as it necessarily must in recent cases of that disease, and also in wounds of the arteries, in which no such opportunity is afforded for an increase in the size of the collateral channels.

Coincident with this effort on the part of the affected structures to establish the collateral circulation, there is generally a feeling of uneasiness, if not of actual pain, of a burning or tingling character, obviously occasioned by the compression which the enlarged and distended vessels exert upon the neighboring nerves. Usually, however, this effect is of short duration, as the nerves soon accommodate themselves to their new relations. After some time, the parts gradually recover their natural functions, all disagreeable sensations vanish, the muscles increase in vigor, and the process of nutrition proceeds apparently as well as it did prior to the deligation of the vessel.

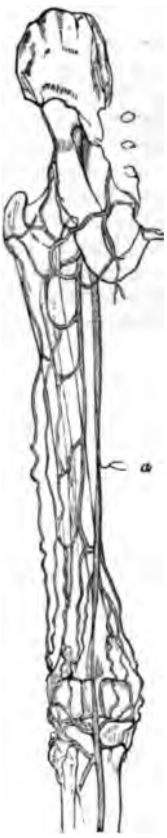
Although such is the ordinary course of events after the main artery of a limb has been tied, yet important exceptions are occasionally met with. Thus, it now and then happens that the circulation remains extremely languid for an unusual length of time, perhaps for a number of days, if not several weeks, the anastomosing branches being seemingly incapable of enlarging to a sufficient extent to convey an adequate supply of blood to the affected structures; the extremity is, consequently, cold, heavy, numb, and of a reddish or purplish hue, from passive congestion of the capillaries, and is moved with pain and difficulty. A struggle is evidently going on between nature and disease, in which the latter but too often comes off victoriously; the limb either falling into gangrene without the occurrence of reaction, or, reaction taking place, it is overpowered by the resulting inflammation. Finally, cases occur, although, fortunately, very unfrequently, in which the parts remain permanently weak and crippled; the muscles are soft and flaccid, the adipose tissue is absorbed, and the integuments are habitually cold and congested; the circulation having never attained the normal standard after the operation.

It is worthy of notice that gangrene, from defective circulation, is much less liable to occur after the ligation of an artery, in the continuity of a limb, in wounds than in aneurism. This fact, at all events, is clearly deducible from the statistical tables of Dr. Norris, from which it appears that in seventeen cases in which the femoral artery was secured on account of recent injuries and different tumors, gangrene did not occur in a single one, whereas this result was witnessed in thirty-one cases out of two hundred and four in which the operation was performed for the cure of aneurism. May not the cause of this disparity be the compression which the tumor in this disease exerts upon the neighboring structures, thereby obstructing the circulation in the distal portion of the limb, and at the same time seriously embarrassing the functions of the nerves? I presume that this result is very materially influenced by the nature of the wound, necessitating the deligation of the artery. If, for example, the parts are extensively divided transversely, or very obliquely, so as to destroy the continuity of a large number of its more important branches in the immediate vicinity of the wound, gangrene will be much more likely to occur than under opposite circumstances, in which the neighboring vessels being but little injured, the blood will easily find its way into the distal structures, thus affording them the requisite supply not only for the preservation of their vitality but also for the maintenance of their nutrition.

Although the capillaries are greatly instrumental in carrying on the circulation in the distal portion of the limb, immediately after the deligation of its main artery, yet their agency is really merely of a temporary character, ceasing with the establishment of the collateral circulation, properly so called, as developed by the larger arterial branches in the vicinity of the ligature. These arterial branches are occasionally given off by the affected artery itself, but most commonly they arise from some neighboring trunks. Thus, when the superficial femoral is tied high up, the collateral circulation is established through the agency mainly of the profunda, whose branches inosculate with the articular, which are offsets of the popliteal. In ligation of the brachial, the blood is transmitted to the forearm and hand by the communications naturally existing between the anastomotic and profunda arteries, branches of the affected vessel, and the recurrent branches of the radial and ulnar, in which the brachial terminates. In ligation, on the contrary, of the common carotid, the circulation of the corresponding side of the head and neck is kept up mainly by the communications between the occipital and deep cervical arteries.

It has been noticed, as an interesting physiological fact, that the anastomotic arteries, before they unite with each other, separate into several branches, often as many as three or four, so as to form a kind of circle, as if nature were particularly anxious to guard against any risk that might otherwise occur to the collateral circulation from accident or disease.

Fig. 230.



Collateral circulation shown in the thigh. At *a*, the femoral artery has been obliterated by ligature.

However established, the collateral vessels gradually augment in size, until, at length, their united capacity is fully equal to that of the obliterated trunk, as in fig. 230, whatever may have been its size. There are, of course, as already stated, exceptions, but they are, probably, much less frequent than is generally imagined. A highly interesting case, beautifully illustrative of the present topic, occurred, some years ago, in the practice of Dr. Francis West, of this city, by whom the particulars have been published in the second volume of the Transactions of the College of Physicians of Philadelphia. The patient, who was a stout, athletic man, aged thirty-two, died suddenly from rupture of an aneurism of the thoracic aorta. On dissection, it was found that this vessel was entirely obliterated, just beyond the remains of the arterial duct, its coats having a constricted appearance, as if they had been embraced by a tightly-drawn ligature. Everywhere else, excepting at the place of aneurism, the aorta was perfectly natural. All the branches of the subclavian arteries were much increased in size; and the internal mammary and epigastric, which served to keep up the connection of the circulation above and below the seat of the stricture, were fully as large as the external iliac, the former having coursed along the walls of the chest in a very tortuous manner. As no tumor was discovered at the seat of the obliteration, Dr. West was unable to determine whether the disease was the result of accident or of a congenital vice. Be this as it may, the case affords an admirable illustration of the manner in which the collateral circulation is carried on after the interruption of the column of blood in such an immense vessel as the aorta.

The collateral circulation is not developed with equal facility at all periods

This book is the pr

COOPER

of life, or under all circumstances; it is most readily established in young subjects, in whom the arteries, besides being very active, enjoy a high degree of elasticity and pliancy, well adapted for such an enterprise. In old persons, on the contrary, the functional activity of these vessels is often much impaired, many of the small branches are obliterated, and their coats are extremely liable to earthy deposits, converting them into firm, rigid tubes, ill qualified for the discharge of their duties. In many cases, loss of blood, ill-health, or defective vital power, seriously interfere with the development of the collateral circulation.

Finally, the collateral circulation may be too active. Such an event is not likely to happen when the main artery of a limb is tied on account of hemorrhage from a wound, but its occurrence is by no means uncommon in aneurism, and is then apt to be followed by a return of the circulation and pulsation in the tumor, in consequence of the activity of the anastomosing branches, which thus continue to feed the sac, and perhaps effectually oppose the cure.

SECT. IV.—HEMORRHAGIC DIATHESIS.

The hemorrhagic diathesis is that peculiar state of the system in which, generally from some slight traumatic cause, there is a strong tendency to an inordinate discharge of blood. Persons who are laboring under this constitutional infirmity are often placed in imminent jeopardy by the most insignificant scratch, puncture, or incision, which, under ordinary circumstances, would hardly emit more than a few drops of blood. Occasionally the cause of the bleeding is the accidental rupture of some of the smaller vessels of the mucous membrane, as, for example, that of the nose, lungs, rectum, or urinary bladder. The extraction of a tooth is sometimes followed by this form of hemorrhage. I recollect one case in which death was produced in this way; and another where the bleeding, having persisted for nearly four days, gave rise to severe exhaustion and great apprehension respecting the safety of the patient. Many years ago I lost a child, six months old, from hemorrhage consequent upon lancing the gums over the upper central incisors, which were nearly ready to protrude; he was affected at the time with cholera, but previously to that he had always been remarkably healthy. The bleeding commenced in less than twenty-four hours after the operation, and continued, despite all that could be done for his relief, until the end of the fifth day, when he died completely exhausted. A short time before he expired, hemorrhagic spots appeared on different parts of the body, and blood began to be discharged from the bowels. In 1857, I operated for strabismus upon a young gentleman who possessed this peculiarity; the division of the internal straight muscle was followed by an oozing of blood, which continued, nearly constantly, for the greater part of a fortnight, when, the wound being almost healed, the bleeding ceased.

The blood in this variety of hemorrhage oozes from the injured part, as water oozes from a sponge; it does not spirt out in jets, as when it comes from an artery, or in a continuous stream, as when it proceeds from a vein. Its color is neither scarlet nor black, but intermediate between the two; it generally partially coagulates when it is received into a vessel, but rarely does so while it is in contact with the living surface.

This affection has occasionally been noticed in several members of the same family. In a remarkable case, reported by the late Dr. John A. Swett, of New York, it existed in all the children, eighteen in number. All except one had died from this cause, and he was suffering under profuse hemorrhage of the nose and rectum. Twelve sisters died before the age of twelve from bleeding of the uterus; two of the brothers had fallen victims to traumatic hemorrhage.

Mr. Wardrop gives a curious case in which this peculiarity was hereditary. The patient was a boy, in whom the hemorrhagic tendency displayed itself when he was scarcely two months old. On several occasions, he nearly lost his life from the most insignificant wounds. His brother, twenty-two years old, was frequently afflicted in a similar way. Of his five uncles, not one was free from this predisposition, three died from the division of the frænum of the tongue, and one from the extraction of a tooth; while the other, although he suffered from the same disease, finally died from some other cause. His two aunts exhibited no signs of this diathesis; but, what is singular, all the male branches of their families, excepting one, were thus affected.

A still more remarkable case has been reported by Dr. Hughes, of Kentucky. The predisposition here was associated with a rheumatic diathesis, and was satisfactorily traced as far back as five generations. It was confined exclusively to the male branches of the different families; but the females, nevertheless, invariably transmitted it to their offspring. Many of the individuals died in infancy and childhood, death resulting, in some, from the cut of the lancet; in some, from accidental wounds; in some, from internal hemorrhage; and in two, simply from the application of blisters, the vesicles being filled with blood instead of water.

Of the immediate *causes* of the hemorrhagic diathesis, we are completely ignorant. Whatever they may be, it is evident that they are deeply engrafted in the constitution, as is proved by the fact, first, that it generally shows itself at a very early age; secondly, that it often occurs in several members of the same family; and thirdly, that it is sometimes hereditary. The immediate causes seem to be two: first, a want of coagulating power in the fibrin of the blood; and, secondly, an imperfectly organized state of the capillary vessels, which are the immediate seat of the hemorrhage.

If one were inclined to speculate in regard to the cause of this defective coagulating property of the blood, it would be easy to find it in an insufficient supply of nervous power, upon the presence of which, as is well known, the vitality of this fluid essentially depends. Whatever has the effect of weakening this influence, proportionably interferes with the concretion of the blood, both as it circulates through the body and after its removal by venesection. The fact that the blood remains fluid in those who are suddenly destroyed by lightning, has long been familiar to practitioners. Similar phenomena occur when a person is killed by a blow on the stomach, by prussic acid, the poison of the rattlesnake, excessive bodily fatigue, or violent agitation of the mind. Certain diseases, as Asiatic cholera, plague, and malignant fevers, produce the same effect. It has been satisfactorily ascertained that, when the pneumogastric nerves are tied in animals, the blood loses its property of coagulating, the coloring matter at the same time separating from the fibrin, and assuming an unusually black color.

But in all these cases, the loss of nervous power is sudden, and hence it is easy to perceive how it should influence the coagulation of the blood. In persons laboring under the hemorrhagic diathesis, on the contrary, the blood is generally habitually indisposed to coagulate, so that they are more or less liable to bleeding whenever they experience any injury, however slight. The analogy, then, between these different states of the system is exceedingly remote, and can, indeed, hardly be said to be established. Its force, moreover, is weakened by the fact that the subjects of the hemorrhagic diathesis generally enjoy as good health, and as much vigor of constitution, as those who are free from it. To say that such persons are constantly laboring under a want of nervous fluid, is to affirm that they are imperfectly organized, and deficient in genuine nerve-power; circumstances which, if true, remain to be proved. I am not aware that any experiments have been made tending to show that the blood in the hemorrhagic diathesis is deficient in fibrin; such observations might be easily instituted, and they could hardly fail to throw important light upon the pathology of this peculiar affection.

The other appreciable element in the pathology of the hemorrhagic diathesis is the want of contractility on the part of the capillary vessels. It has been supposed that this is due to the absence of the middle tunic of these vessels; but such a deficiency must necessarily be a matter of inference rather than of observation, and I am not aware that any one, whose opinion is entitled to much weight, any longer holds such a view. That there is a want of tone in the capillaries is certain, but how this is brought about, or in what it consists, is still a subject of conjecture.

The *prognosis* of this form of hemorrhage is generally not very favorable, particularly when it is of a hereditary nature, in which event it is extremely liable to prove fatal. In the case related by Swett, seventeen out of eighteen members of a family thus affected had perished, and the survivor himself had repeatedly suffered from severe bleeding in different parts of the body. In the case of Hughes, in which the diathesis prevailed in not less than five generations, nearly every individual died from hemorrhage; many of them in infancy and childhood.

In the *treatment* of the hemorrhagic diathesis, two indications are presented: the first is to promote the coagulability of the blood; the second, to increase the contractile power of the capillary vessels. In addition to these, it will be necessary, if a good deal of blood has already been lost when the surgeon is called to the case, to support the system by tonics and a nutritious diet.

The first of these objects is best fulfilled by the judicious use of acetate of lead and opium, the former of which seems to exert a direct influence upon the coagulability of the blood, while the latter affords important aid in controlling the action of the heart, generally rendered turbulent by the bleeding and the patient's mental anxiety. The dose of the salt should vary from half a grain to a grain and a half, every two, three, or four hours, according to the tolerance of the stomach and the amount of hemorrhage, and should contain at least one grain of opium, or its equivalent of acetate of morphia. If heat and dryness of skin exist, a small quantity of antimony or ipecacuanha may be added to each dose, to produce perspiration. Severe depression, however, must be vigilantly guarded against. If there be much cardiac action, tincture of aconite or veratrum viride should be given, its effects upon the system being carefully watched. Whatever else be done, it is of paramount importance, in every case, to control and quiet the heart's action.

To increase the contractility of the capillary vessels, which is the next indication, provided this has not been effected by the acetate of lead, recourse must be had to tonics and nutritious diet. Of the former, one of the best articles, according to my observation, is the tannate of iron, either alone or in union with quinine, in doses varying from two to five grains, administered every two, three, or four hours, in pill form. The diet should be light, non-stimulant, and nourishing, and moderate use should be made of milk punch, toddy, or wine. In general, these measures will be borne, having a tendency rather to quiet the action of the heart than to occasion undue excitement. Tranquillity of mind and body is of paramount importance, and must, therefore, not be neglected.

Purgative medicines will usually prove highly serviceable, both as evacuants, as counter-irritants, and as restorers of the secretions, which are nearly always much disordered in this variety of hemorrhage. Estimating these remedies at their real value, I am satisfied that they are entitled to the highest rank in the treatment of this affection; they must not, however, be carried too far, otherwise they may induce irritability of the heart, and thus do harm instead of good. If the patient be plethoric, he may take sulphate of magnesia, which is particularly appropriate under such circumstances, on account of its chemical action upon the blood; or, what will generally be better, especially when there is marked derangement of the secretions, a full dose of calomel and compound extract of colocynth.

If the bleeding be attended with fever, or with heat and dryness of the surface, recourse must be had to diaphoretics, as antimony and morphia, or the neutral mixture, aided by tepid ablutions. Coldness of the extremities must be relieved by hot mustard baths.

It need hardly be added, that the sooner these constitutional measures are carried into effect, the more likely will they be to prove efficient in arresting the hemorrhage; the longer the bleeding has lasted, or the greater the amount of blood that has been lost, the more difficult will it be to arrest the disease and prevent its downward tendency. Moreover, a proper plan of treatment having been selected, it should be diligently persisted in until it is capable of exerting its beneficial influence, and not be constantly varied, as is so often the case in the hands of the timid and inexperienced; it being never forgotten that some time must necessarily elapse, in such a case, before the system can be favorably impressed by any measures, however judicious or energetic.

The topical treatment is often of paramount importance. When the hemorrhage proceeds from a wound, the affected structures should, if possible, be included in a firm ligature. For this purpose, the twisted suture may be used; or, if this be impracticable, systematic compression may be made by means of a graduated compress and roller, the surface of the wound having previously been dried, so as to allow the lint to come directly in contact with the bleeding orifices of the divided vessels. The efficacy of the compression will sometimes be increased by the use of a piece of tinder, placed upon the raw surface, or by soaking the lint in a saturated solution of alum. Perchloride and persulphate of iron may also be tried, though their efficacy has been greatly overrated as anti-hemorrhagics. Occasionally, the application of pounded ice will restrain the bleeding more effectually than anything else. Rubbing the wound freely with nitrate of silver or sulphate of copper is sometimes useful. The actual cautery, the Vienna paste, and the different acids, have all been recommended when the hemorrhage resists the more ordinary measures; but the objection to them is that, when the eschar drops off, and frequently even before, the bleeding is apt to recur with increased violence. Finally, when the blood proceeds from the nasal cavity, uterus, or rectum, the most efficient adjuvant will be the tampon.

SECT. V.—DISEASES OF THE ARTERIES.

The arteries are liable to inflammation, acute and chronic, suppuration, softening, ulceration, and various kinds of transformations.

1. ACUTE INFLAMMATION.

Acute arteritis is generally induced by external injury, or by an extension of disease from the adjoining structures. Nevertheless, it occasionally exists as an idiopathic affection, or comes on without any assignable cause, chiefly in persons of a gouty or rheumatic predisposition, from the age of thirty to fifty. Restricted, in the majority of instances, to one or more of the larger trunks, it not unfrequently involves the smaller branches, and sometimes even the capillaries. Occasionally, the disease appears to pervade nearly the whole arterial system.

When arising spontaneously, the disease usually begins in the internal membrane and subserous cellular tissue, from which it gradually spreads to the other tunics; the reverse happening when it is induced by external violence. The anatomical characters of acute arteritis are redness, opacity, rugosity, and softening of the lining membrane, with an engorged, lacerable, and thickened state of the outer and middle coats. When the inflammation is severe, the parietes of the affected artery are generally remarkably pulpy, and so much diminished in consistence as to be easily torn or divided by the ligature. The nutrient vessels are loaded with blood, and often exhibit a real varicose aspect, their ultimate twigs ending apparently in the subserous cellular substance. With regard to the redness of the internal membrane, it is liable to considerable diversity; generally speaking, it occurs in small patches, which are diffused over a considerable extent of surface, and which vary in diameter between that of a split pea and a five-cent piece. In intensity, it ranges from a light pink to a deep scarlet, through numerous intermediate shades of lilac and purple. In some instances the redness is uniform. With this change of color are always associated important alterations of texture. The inner membrane, losing its smoothness and polish, assumes a rough, fleecy aspect, and, owing to the softened state of the subserous cellular tissue, is easily detached from its natural connections. Globules of lymph, either alone or blended with pus, occasionally adhere to its inner surface; and, in the larger arteries, it is not uncommon to meet with well-developed pseudomembranes, similar, in all respects, to those of the serous textures. The other tunics are also much affected, being moist, tumid, friable, and transformed into a reddish, homogeneous mass, almost devoid of cohesive power. Their elasticity, naturally so great, is partially lost, and in many instances they are freely infiltrated with serosity, sanguinolent fluid, or even pure pus. A common occurrence is the formation of fibrinous concretions, closing up the caliber of the affected vessels.

Suppuration of the arteries is probably more frequent than is commonly imagined. The matter being generally formed upon the inner surface of the vessels, is soon swept away by the circulating current which is, doubtless, the reason why it is not oftener noticed after death. Sometimes, however, it is entangled in the substance of the false membranes, infiltrated into the arterial tissues, or collected into small abscesses between the inner and middle tunics. Arteritis is much less liable to terminate in suppuration than phlebitis, in which respect the one resembles inflammation of the serous membranes, the other of the mucous.

The arteries are almost insusceptible of *gangrene*. Their conservative powers are certainly very great, and hence they often escape destruction in the midst of parts that are perfectly deprived of vitality. In such cases, their outer surface becomes incrusted, at an early period of the disease, with a thin layer of fibrin; and, long before the sloughs begin to separate, the blood coagulates in their interior, thus opposing an effectual barrier to the occurrence of hemorrhage.

Softening of the arteries is a common occurrence, especially in the smaller branches. It is often witnessed in organic diseases of the principal viscera, and is a frequent attendant upon acute inflammation, cancerous affections, and the application of the ligature. The lesion is characterized, as the name indicates, by a diminution of the cohesive power of the vessels, the coats of which are rendered friable, spongy, and inelastic. It is generally accompanied with slight tumefaction, engorgement of the capillary vessels, and effusion of serosity, or sanguinolent fluid into the interstitial cellular tissue.

The *symptoms* of acute arteritis are generally so obscure as to render it extremely difficult to distinguish it, especially when it occurs in the more deep-seated vessels. In the majority of cases, the attack strongly resembles one of rheumatism. The most reliable phenomena, in a diagnostic point of view, are excessive pain and tenderness along the course of the affected arteries, increased by pressure, cough, and change of posture, and accompanied by violent and tumultuous throbbing, which is sometimes felt over the greater portion of the body, and may often be easily perceived at a considerable distance. The action of the heart is much increased in force and frequency, the pulse is hard, wiry and thrilling, and the system is disturbed by irritative fever, which rapidly assumes an asthenic type. When the disease is at all extensive, the patient soon succumbs under its influence, the immediate cause of death being either exhaustion from the violence of the inflammation, or from the formation of the fibrinous concretions in the larger arteries, thereby arresting the circulation in some of the more important organs.

There are no symptoms denotive of suppuration, ulceration, or softening of the arteries, apart from those of acute or chronic inflammation. The formation of matter would probably be ushered in by rigors, followed by copious sweats, hectic irritation, and excessive prostration, but the occurrence would hardly be of so marked a nature as to serve any diagnostic purpose.

The *treatment* of acute arteritis must be conducted upon general antiphlogistic principles; by the lancet, purgatives, and antimonials, if the patient be young and plethoric, or by a conservative course, if he be weak, decrepit, or exhausted by previous suffering, intemperance, or dissipation. Aconite, veratrum, or colchicum will usually form valuable additions to the other means, especially if they be combined with morphia, which is so necessary to allay pain and quiet the heart's action. If the disease is connected with a rheumatic diathesis, calomel must be given, in full and frequently repeated doses, with a view to early but gentle ptyalism. Colchicum will also prove useful in such a case. The most suitable topical remedies, when the affected arteries are superficial, are leeches, iodine, and saturnine lotions, in union with laudanum.

2. CHRONIC AFFECTIONS.

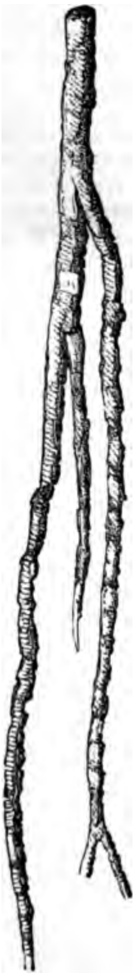
The most common chronic affections of the arteries are the fibrous, earthy, and atheromatous transformations, which, although of frequent occurrence, are chiefly interesting in relation to the influence which they exert upon the production of spontaneous aneurism. It is for this reason, therefore, that they should be carefully studied. These transformations, notwithstanding that they differ from each other widely in their physical and chemical properties, possess several characters in common, of which the most important are, first, that they are met with almost exclusively in elderly subjects; secondly, that they render the coats of the vessels brittle, and consequently prone to rupture; thirdly, that they nearly always occur in association with each other; and, lastly, that they usually begin in the cellular tissue, between the inner and middle tunics, which, however, in time, commonly participate in the degeneration.

The *fibrous transformation* is characterized by the appearance of small, hard, firm patches beneath the serous layer of the arteries, usually isolated, but sometimes grouped together, of no definite shape, thin, and of a whitish, grayish, or pale yellowish aspect. When the patches are numerous or unusually large, they convert the affected arteries into firm, inelastic tubes. The matter which gives rise to this transformation is originally deposited in the form of fibrin, which gradually assumes the properties here assigned to it.

The *earthy degeneration* is most common in old subjects after the sixtieth year; it usually, however, begins to form as early as the forty-fifth, and cases of it have been observed in very young children. Although it may take place in any of the arteries, it is most generally met with in the aorta and its larger branches, as the iliac, femoral, popliteal and innominate. What is remarkable, and, in the present state of the science, altogether inexplicable, is, that, while the artery of the thigh is so frequently ossified, the humeral artery is seldom affected. Another fact, not less singular, is that this transformation is comparatively rare in the female; a fact which satisfactorily accounts for the difference in the relative frequency of spontaneous aneurism in the two sexes. We occasionally meet with an instance in which there is a strong ossific diathesis, or tendency to this degeneration, nearly all the arteries in the body being converted into rigid cylinders. The earthy matter is deposited in an amorphous form, and is destitute of bone corpuscles; consisting essentially of phosphate and carbonate of lime, in combination with a small quantity of albumen, which apparently serves as its matrix.

The calcareous matter exists in various forms; sometimes in small grains and nodules, now in scales, plates, and patches, and now in complete rings, which, encircling the vessel, convert it into a firm, rigid, inflexible tube, completely destitute of its natural attributes, as seen in fig. 231. The inevitable effect of these changes, which are always most conspicuous in the inner coat, is to render the artery abnormally brittle, and, therefore, ill able to withstand the pressure of its contents.

Fig. 231.

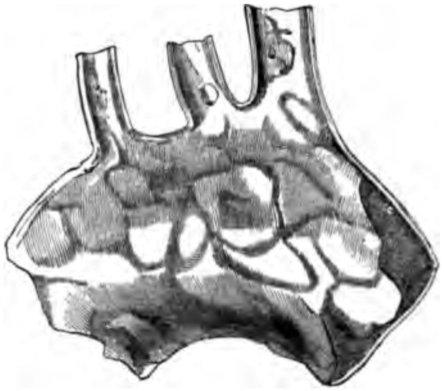


Deposition of calcareous matter.

The starting point of this deposit is the subserous cellular tissue, whence it gradually extends to the substance of the inner and middle tunics, both of which are sometimes completely transformed by it. It is rare that the outer coat suffers from it; such a change, however, is not impossible, and I have seen specimens in which the deposit was apparently entirely restricted to it. The exciting cause of the calcareous transformation is chronic inflammation. That this is the case is rendered clearly manifest by the fact that it is invariably accompanied by more or less thickening and induration of the arterial tunics, independently of those produced by the deposit itself.

The *atheromatous* deposit, fig. 232, now usually denominated the *fatty degeneration*, is, I believe, very rare among our native inhabitants, although it appears to be sufficiently common in our emigrants, especially the Irish and English. In Europe, it is said to be more prevalent in Great Britain than in any other country; a fact which accounts for the remarkable

Fig. 232.



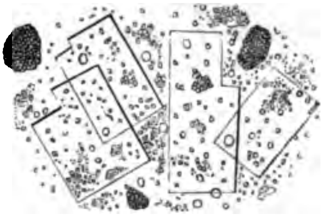
Atheromatous deposits.

frequency with which aneurism occurs in that part of the world. However this may be, the deposit always begins in the subserous cellular substance, generally in minute, isolated points, not larger than the head of a pin, of a pale yellowish, whitish, or brownish color, somewhat greasy to the touch, and of a semi-concrete, friable consistence. In time, many of these points, or dots, coalesce, and so form irregular-shaped patches, which, pushing the lining membrane before them, may involve the whole circumference of the tube, and extend several lines or even inches up and down in the direction of its length. Having remained stationary for an indefinite period, the deposit manifests a disposition to softening and disintegration, and is ultimately converted into a curdy, friable, or, more properly speaking, a pap-like substance, possessing, apparently, all the properties of scrofulous pus. At this stage of the disease, the lining membrane is often elevated into small pustules, or little abscesses, which, bursting, discharge their contents into the blood, thus leaving a corresponding number of ragged and irregular ulcers, the base of which is formed by the middle tunic.

The fatty deposit is most common in the aorta, particularly its thoracic portion, near the origin of the great cervical trunks. Its occurrence is almost peculiar to the aged. What the causes are, under whose influence it is developed, has not been ascertained. That it is occasionally connected with imperfect alimentation, and the inordinate use of ardent spirits is unquestionable, but that these circumstances are essential to its production, as some pathologists contend, is what we cannot admit; because the disease, as is well known, has been frequently witnessed in the stoutest and most temperate subjects, a fact which is entirely at variance with such a conclusion.

Under the microscope the atheromatous matter is observed to consist of albuminous and earthy particles, of crystalline plates of cholesterine, of an imperfect fibrous texture, and of oil globules. The amount of fatty substance is frequently so great that it imparts a greasy stain to paper when dried on it by heat. The minute appearances of this deposit are well shown in fig. 233.

Fig. 233.



Fatty granules, with crystals of cholesterine, from atheromatous deposits in the aorta.

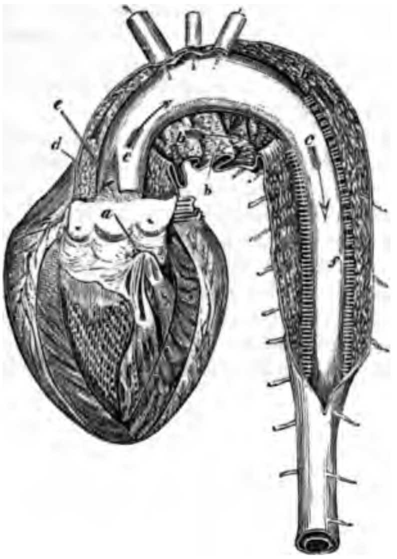
In regard to the different transformations now described, there are no remedies, which, so far as is at present known, are capable of exerting any influence over their development. What treatment might accomplish, if their diagnosis could be satisfactorily established, is an interesting problem for future inquiry to solve. To speak of administering remedies for their removal when we are unable to determine the fact of their existence is one of those practical refinements which are more befitting the transcendentalist and the idle speculator than the man of sound sense.

Ulceration, as a consequence of arteritis, whether acute or chronic, is seldom witnessed. Manifesting a peculiar predilection for the larger trunks, it commonly commences in the serous membrane, from which it gradually extends to the middle and outer tunics until it leads to complete perforation. Such a termination, however, is extremely rare. The ulcers, which are very irregular in respect to their form, vary much in their size, number, and general characters. At times they are very small, scarcely exceeding the diameter of a mustard-seed; but they may be as large as a split pea, a five cent piece, or even a guinea, according to the size of the affected tube. Their margins are usually ragged, irregular, and considerably elevated, but seldom injected; their bottom, which is rough and uneven, is commonly formed by the middle tunic, the fibres of which frequently present a shreddy, lacerated appearance. In many instances, the erosions look like so many fissures, cracks, or chaps, with sharp, prominent, and irregular borders. This form of the disease is ordinarily dependent upon the presence of calcareous matter. The number of ulcers is seldom considerable, though in a few rare cases the inner surface of the larger trunks has been found completely checkered with them. When confined to the internal tunic they sometimes admit of cicatrization.

3. INTRA-PARIETAL SEPARATION.

There is an affection of the arteries, occurring exclusively in old persons, more particularly in women, to which the term *dissecting aneurism* has been applied; it is not, however, in reality, an aneurism at all, but merely a separation of the lamellæ of the middle tunic, as has been satisfactorily established by the investigations of Dr. Pennock, and by an examination by myself of nearly all the reported cases of the disease. A more appropriate name would be *intra-parietal* separation. The lesion, which presents nothing of any practical interest, inasmuch as it is always fatal, is entirely limited to the aorta and the larger trunks more immediately connected with it, and is always dependent upon organic disease of the coats of the arteries, rendering them lacerable, and, consequently, incapable of resisting the impulse of the blood. The manner in which the affection takes place is easily understood. In the natural state the different coats are so intimately connected together that it is almost impossible, even by the nicest dissection, to detach them from each other; but when they are altered by disease, or by some of the degenerations to which they are so liable, the connecting cellular tissue is rendered soft and friable, and their separation may then be effected with the greatest facility. In this condition, moreover, the tunics themselves are frequently very much changed, so that they are scarcely able to resist the slightest impulse. Now, if under these circumstances the lining membrane gives way, whether from ulceration, erosion, or rupture, the blood will insinuate itself into the accidental opening, which is thus gradually enlarged, at the same time that the fluid is forced on between the layers of the weakened middle tunic, dissecting them from each other as with a knife, and forming thus either a blind pouch or a distinct canal, open at both extremities, or at some intermediate point.

Fig. 234.



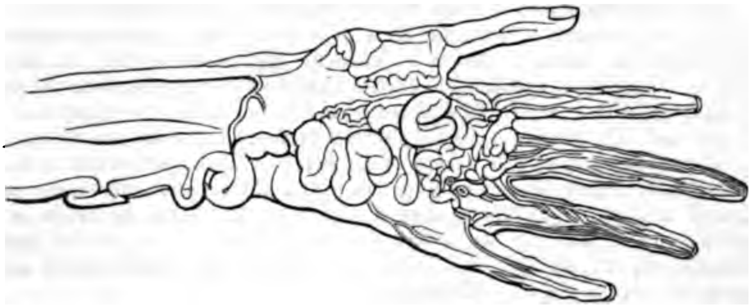
The so-called dissecting aneurism. *a*. Semilunar valves; *b*. External vessel laid open in its entire extent, so as to expose the aorta at *c*; *d*. Valvular opening in the coats of the aorta, showing the communication of this vessel with the artificial channel, *b*; the probe *e* passed through the abnormal opening; *f* exhibits the foramina between the aorta and the outer canal.

The separation is not of the same extent in all cases. It rarely embraces more than one-fourth, one-half, or two-thirds of the circumference of the tube, while in length it may vary from six, eight, or ten lines to as many inches. Occasionally it reaches nearly from one extremity of the aorta to the other, being perhaps prolonged at the same time into the carotid, subclavian, and iliac arteries.

4. VARICOSE ENLARGEMENT.

The arteries are liable to a dilated and nodulated condition, similar to that of the veins, and hence very frequently termed varicose enlargement. The affection has also been described under the name of varicose aneurism and of arterial varix. Its general features are well illustrated in fig. 235. The lesion, which is exceedingly rare, is met with chiefly in the superficial arteries, particularly in those about the head, the forearm, hand, leg, and foot; and consists in a remarkably tortuous, elongated, and convoluted state of these vessels, evidently dependent upon the effects of inflammatory action, as is shown by the fact that their coats are always abnormally thickened, either uniformly, or alternately thickened and attenuated. In elderly subjects it is generally associated with the fibro-cartilaginous, earthy, or fatty degeneration. The dilatation and varicosity sometimes affect an entire artery, but more commonly they are limited to particular portions of it; it may be restricted to one vessel, or occur simultaneously in several. When the diseased artery is superficial, the character of the lesion is rendered sufficiently clear by the tortuous and nodulated course of the vessel beneath the surface; but there are no pathognomonic signs when it is deep-seated.

Fig. 235.



Varicose enlargement.

This affection rarely requires any treatment; for, even when the enlargement is considerable, it is rather an inconvenience than an actual disease. In ordinary cases, the vessels may be supported by the constant use of a well-applied bandage, or of an apparatus constructed upon the principles of the laced stocking. During the forming stage, much may be done in the way of repressing development by astringent and soothing lotions, along with rest and elevation of the parts, and the occasional abstraction of blood, provided the patient be plethoric, in order to moderate the momentum of the circulation. When the disease proves troublesome, by causing pain and functional disorder, the only effectual remedy is ligation of the offending vessels, at the cardiac side of the enlargement.

SECT. VI.—ANEURISM.

An aneurism is a pulsating tumor, occupied by blood, and communicating with an artery deprived, either in part or completely, of its integrity.

The subject of aneurism has been encumbered by too many divisions and subdivisions, and the consequence is that several lesions have been included under it which do not, properly speaking, appertain to it. The effect of this over-refinement has been to embarrass the study of this disease, and to invest it with difficulties which are altogether foreign to it. The distinction of aneurism into true and false is one of great importance, and should, therefore, be retained. The same may be said in regard to spontaneous and traumatic aneurism. The term dissecting aneurism, introduced by Laennec, and adopted by most modern authors, should be discarded, inasmuch as the affection which it serves to designate has nothing whatever in common with aneurism; it is, in fact, as already stated, merely a separation of the coats of the arteries, without any tumor or symptoms denotive of that lesion. Then, again, as to the term varicose, which I have myself employed, along with others, in my writings, to designate a peculiar form of arterial lesion, it is obviously improper when we come to make a practical application of it. A varicose artery is, in reality, no more an aneurism than a varicose vein; both affections consist essentially in a dilated and tortuous state of these two classes of vessels, and not, like aneurism, in a pulsating tumor, caused by the destruction, partial or complete, of the tunics of an artery. An anastomotic aneurism is a pulsating tumor formed by hypertrophy of the arterial and venous capillaries of a part; critically speaking, therefore, the term aneurism is not applicable to it, and yet, as it has been fully engrafted upon our surgical nomenclature, it is difficult to dispense with it, or to substitute one of a more expressive and appropriate character.

The term true is applied to that species of aneurism in which one or more of the arterial tunics, without being necessarily perfect, form a part of the tumor. A false aneurism, on the contrary, is one in which all the coats have given way, the sac being composed of the surrounding cellular tissue in a state of condensation. It was formerly supposed, chiefly through the influence of the writings of Scarpa, that there was no such disease as a true aneurism, but that in every instance, whatever may be the size, form, or site of the affection, there was a complete absence of the arterial tunics at the situation of the tumor. This opinion, however, has become obsolete, experience having shown that there are cases, although they are confessedly rare, in which the aneurism clearly consists of at least one, if not more, of the coats of the artery from which it springs. Each of these great divisions comprises several varieties, founded principally upon the form and volume of the tumor. Thus, an aneurism is said to be sacculated when it consists of a distinct bag, as so often happens in aneurism of the aorta and the principal branches given off from it; the term cylindroid is used when the swelling affects the artery uniformly in its entire circumference, while the tapering tumor is known by the appellation of fusiform. The words circumscribed and diffused refer merely to the dimensions of the aneurism.

Fig. 236.

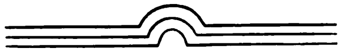


Fig. 237.

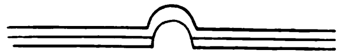


Fig. 238.

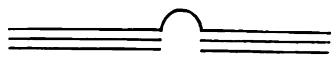
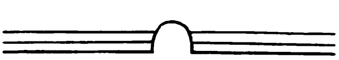


Fig. 239.



The annexed sketches afford a good idea of the arrangement of the tunics of the arteries in the principal varieties of spontaneous aneurism. In fig. 236 the tumor is formed by the expansion of all the coats of the vessel, an extremely rare event; in fig. 237 the middle tunic has given way, the inner and outer being preserved; in fig. 238 the aneurism is formed by the external tunic alone; in fig. 239 the two outer membranes have been ruptured, the inner projecting through the crevice thus left, in the form of a hernia.

This variety is very uncommon, but cases of it have been reported by different authors, especially by Haller, Laennec, Dupuytren, and Dubois. It can occur only when the inner coat of the artery has been thickened and fortified by interstitial and surface deposits.

Finally, aneurisms are divided into internal and external, the former expression being used chiefly in reference to the aorta and to the arteries of the viscera, the latter in relation to the vessels of the extremities, the head, and neck. The words spontaneous and traumatic sufficiently explain themselves.

1. LOCALITY, PREVALENCE, AGE, SEX, AND CAUSES.

Spontaneous aneurism does not occur with equal frequency in all parts of the body; on the contrary, there are a number of arteries which are almost entirely exempt from it, or which, at all events, so seldom suffer as to be scarcely entitled to notice. The vessel which is most frequently involved is the aorta; first in its ascending portion, then in the thoracic, and, lastly, in the abdominal. Next in point of liability to the disease are the popliteal artery, the femoral, common carotid, subclavian, innominate, axillary, and external iliac. The arteries of the leg and foot, the hand, forearm, and arm, the face, upper part of the neck, and of the viscera, together with the common and internal iliac, rarely suffer in this wise. Traumatic aneurism may occur in any of the arteries, but is most common in such as are most exposed to external injury.

If we attempt to inquire into the causes which induce spontaneous aneurism more frequently in one artery than in another, we shall be met by difficulties. Several circumstances, however, may be assigned as affording at least a plausible explanation of the circumstance.

1st. It is well known that certain arteries are peculiarly prone to the calcareous and atheromatous degenerations, while others, on the contrary, are almost entirely exempt from them, whatever may be the condition of the rest of the arterial system, or the age of the patient. Now, dissection has shown that those vessels which are most frequently diseased in this way are also those which are most frequently affected with aneurism, and conversely. Spontaneous aneurism of the arm and forearm is among the rarest occurrences, and everybody knows how free their vessels are from the degenerations in question. In the aorta and popliteal artery, on the other hand, they are extremely common, and it is here, as already seen, that spontaneous aneurism is most frequent.

2d. In the next place, some influence is no doubt due, in the production of this difference, to the force with which the blood impinges against the walls of the vessels. Thus, in the aorta, which is more prone to aneurism than any other vessel, the ascending portion, particularly its anterior and right side, suffers more frequently than any other part, and it is here that the blood exerts its greatest force, as it is pumped up from the left ventricle. The popliteal artery, which comes next in the order of involvement, is subjected, in a degree beyond that of any other vessel in the extremities, to a similar influence during the flexed condition of the limb.

3d. It is not improbable that some influence is also due to the weakness which the arteries experience at the origin of their larger branches. The fibres of the middle tunic suffer a species of separation here, in consequence of which they are less capable of withstanding the shock of the blood as it is directed against them. However this may be, experience teaches that aneurism is peculiarly liable to occur at these points.

4th. Another circumstance which may be supposed to favor the production of aneurism is the motion to which the arteries are subjected, especially during sudden and violent efforts. Such an influence must be particularly felt by the ascending portion of the aorta during bodily and mental excitement, and by the popliteal artery in the various muscular exertions of the lower extremity.

How far any one of these causes alone is capable of producing aneurism is altogether a matter of conjecture. Without degeneration of the arterial tunics, they would probably exert but little influence, while under opposite circumstances it must be very great. Indeed, it is very questionable whether aneurism would be one-twentieth part as common as it is, if the arteries were altogether exempt from the earthy and atheromatous deposits; nay, we may go further, and assert, positively, that if these deposits could be prevented, spontaneous aneurism would almost cease to exist.

The occurrence of aneurism would seem to be influenced by climate or *locality*. The infrequency of the lesion in the inhabitants of the southwestern States of North America, is proverbial. In a practice in Ohio and Kentucky of twenty-three years, in which I witnessed almost every surgical disease incident to the human race, it rarely occurred to me to meet with an example of spontaneous aneurism. My experience, in this respect, is fully sustained by that of Dr. Dudley, of Lexington, whose practiee embraced a wide field, which has since been so successfully cultivated by Professor Bush, of Transylvania University. Both these gentlemen assured me, some years ago, that this affection had been extremely rare within the range of their observation. Professor T. G. Richardson, now of New Orleans, superintended, while Demonstrator of Anatomy in the University of Louisville, the dissection of several hundred bodies, and yet he hardly met with an instance of the malady. The testimony of Dr. Bayless, who formerly occupied the same position, is precisely to the same effect. To what this extraordinary immunity is due, we have no means of determining. The population of that region of the United States is a mixed and laborious one, made up from all parts of the civilized world, and pursuing all kinds of occupations, from the most delicate and refined to the most rude and vigorous, and yet a case of spontaneous aneurism, in any class of its citizens, is absolutely an anomaly. My impression is that the disease is equally uncommon in our northern and middle States; but upon this subject it is necessary to speak with some degree of reserve, as we have no positive data to guide us.

In regard to the prevalence of aneurism in our larger towns and cities, our information is also very imperfect. Professor Gibson, formerly of the University of Pennsylvania, asserts that the disease is quite infrequent in Philadelphia, and this I am inclined to believe to be the fact, from the results of my own inquiries. In New York, on the contrary, it would seem, according to the statement of Dr. Mott, to be quite frequent; a circumstance which is, perhaps, not surprising, when we consider the heterogeneous character of the people of that city, and, above all, the extent of its commerce, and the numerous accidents incident to its pursuits. What is remarkable, however, is, that nearly all the cases met with by this distinguished surgeon, during a period of upwards of forty years, occurred among native-born citizens of the United States. In opposition to this fact, however, I have the authority of Dr. John Watson and others, of New York—as communicated to me by Dr. Lente—for stating that the great majority of cases of aneurism in that city, especially in hospital practice, are met with among those of foreign birth. The negroes of that city would also seem to be particularly obnoxious to the disease.

Aneurism is uncommon in the East and West Indies, in the British Provinces of North America, and on the continent of Europe, especially France, Italy, and Germany. In Great Britain, on the contrary, it is sufficiently frequent; more so, perhaps, than in any other part of the globe. According to the report of the registrar-general, it appears that the number of deaths from aneurism, in England and Wales alone, during a period of five years—namely, from 1838 to 1842—was 593; being an annual average of one in about 131,000 of the inhabitants. The various hospitals of London receive every year a large number of cases of this disease. The people of Ireland are said to suffer more frequently from aneurism than any other race.

The *causes* of aneurism are divisible into predisposing and exciting. Of the former, the most constant, and, therefore, the most important, is a diseased condition of the arterial tissues, usually presenting itself in the form of the earthy and atheromatous degenerations. These degenerations, by rendering the coats of these vessels preternaturally brittle and lacerable, cause them to yield more readily under the impulse of the blood and the various extraneous circumstances which have a tendency to stretch and twist them. I have already expressed the belief that, but for these alterations, spontaneous aneurism would be almost unknown. The influence of age and climate in the production of this disease, is adverted to in the preceding paragraphs. All laborious pursuits, involving sudden and violent muscular exertion, powerfully predispose to its occurrence. Hence, it is more common among sailors, and those who are much accustomed to athletic exercises, than among any other class of individuals. Soldiers suffer much less frequently than was formerly supposed. Men engaged in agricultural pursuits, although their labor is often severe, are, in great measure, free from the disease, owing, doubtless, to the want of liability of their arteries to abnormal deposits. Protracted courses of mercury, a syphilitic taint of the system, and the constant and inordinate use of ardent spirits, are supposed to predispose to the formation of aneurism; but how far, or in what degree, remains to be demonstrated.

The immediate cause of aneurism is rupture of the coats of the arteries, in consequence of severe muscular exertion unduly stretching these vessels; or, as in the case of the aorta and its larger offsets, an inordinate impulse of the blood, during the sudden and violent contraction of the left ventricle of the heart. The vessels, weakened by the degeneration of their tissues, and deprived of their elasticity, readily yield to the forces thus applied, commonly at a particular point, which is afterwards converted into a distinct pulsating tumor, composed generally, in great measure, if not exclusively, of the external tunic of the artery along with more or less of the circumjacent cellular tissue. Sometimes the exciting cause of the disease is ulceration, but such an occurrence is comparatively rare, especially as an affection unconnected with the earthy and atheromatous deposits. This process, as stated in a previous section, should not be confounded with the cracks or fissures which so often follow these deposits, seeing that the latter are usually the result, not of a vital action, as is the case in true ulceration, but of a mere mechanical one, gradually effected under the impulse of the blood, as it rushes over the inner coat of the diseased vessel.

Aneurism occasionally exists simultaneously in several arteries. Thus, it is by no means uncommon for a patient to have one tumor of this kind in the aorta and another in the carotid, subclavian, popliteal, femoral, or external iliac artery. I have seen several instances of the co-existence of popliteal aneurism in the same individual. When the disease affects a considerable number of arteries, it constitutes what is termed the *aneurismal diathesis;* a circumstance which imperatively contraindicates surgical interference, however favorably the external tumor may be situated for operation. Weak, sickly persons, of depraved constitution, and intemperate habits, are the most common subjects of this diathesis. Several remarkable examples of this predisposition to the formation of aneurism are upon record. Pelletan gives one in which the number of tumors was upwards of sixty, and in another, related by J. Cloquet, there were more than two hundred, the patient being a man fifty years of age. The aneurisms, in this instance, affected nearly all the arteries in the body, but they were most numerous in those of the extremities, the axillary, humeral, radial, ulnar, femoral, popliteal, tibial, and peroneal being all closely studded with them.

It has long been known that the formation of aneurism is influenced, in a remarkable degree, by *age*. Prior to the age of thirty, the disease is extremely rare, and up to the period of puberty it is almost unknown, even in the aorta, which is so much more frequently affected than the other vessels. The greatest number of cases, by far, occur between the thirty-fifth and fiftieth year; a good many cases are also met with during the next decennial period and a half, but after that time the malady is very rare; probably not that the predisposition to it ceases, but because, as it seems to me, in the first place, the number of subjects is comparatively small; and, secondly, because persons at this age are much less exposed to violent muscular and mental excitement than during the meridian of life. That this supposition is true, is rendered highly probable by the fact that the earthy and atheromatous deposits generally exist in greatest abundance in advanced life. The absence of these deposits in young subjects readily explains the non-occurrence of aneurism in children and adolescents. An instance of spontaneous popliteal aneurism in a boy only nine years old occurred in the practice of Mr. Syme, of Edinburgh, in 1844, and is the only case at this early age upon record.

Males suffer from aneurism more frequently than females, but in what precise proportion has not been determined. The question has hitherto engaged but little attention, and it is obvious that it can be decided only by the analysis of a much larger number of cases than have yet been adduced for the purpose. It has been alleged that the relative frequency of carotid aneurism in the two sexes is nearly equal, and the occurrence has been attempted to be accounted for on the supposition that the arteries of the neck of the female are nearly as much exposed to all kinds of violence and muscular exertion as those of the male. Little confidence, however, can be placed in such opinions; for, before we can receive them as true, we must be satisfied that the disease is as common in women as in men, which I am very certain it is not. Mr. Crisp, in his excellent work on the diseases of the arteries, states that of 551 cases of aneurism of all kinds, more than seven-eighths occurred in men.

Having long been impressed with the belief, founded upon numerous dissections, that the difference in the relative frequency of aneurism in the two sexes was due, not to any difference in their occupation, but to the difference in the relative frequency of the earthy and fatty degenerations of the arteries, I was induced to institute special inquiry into the subject, and am gratified to be able to say that my views are fully confirmed by the statements of Dr. D. Hayes Agnew, Dr. C. E. Isaacs, Professor T. G. Richardson, and Professor J. B. S. Jackson. The testimony of these teachers, who are all well known as able and experienced practical anatomists, tends to show, indisputably, that females are much less subject to chronic disease of the arteries of every description than males. Neither their information, however, nor my own, is such as to enable me to determine the relative proportion of these degenerations in the two sexes, in a given number of cases. That it corresponds very closely with the difference in the number of cases of aneurism is what may readily be believed, and what future observation will, no doubt, abundantly verify.

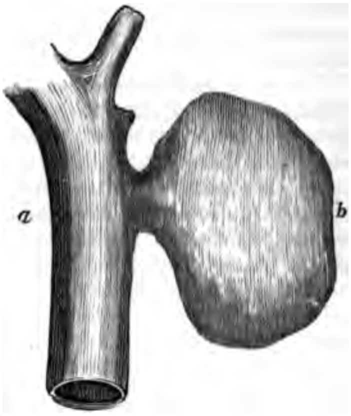
If we assume what is here said to be true, it follows that the opinion which ascribes the greater frequency of spontaneous aneurism in males than in females to their more laborious occupation, their more intemperate habits, and their greater exposure to all kinds of disease, is entirely untenable, and, therefore, unworthy of confidence. Women, it is true, are not sailors, carpenters, blacksmiths, or hod-carriers, but in many parts of the world they are tillers of the soil, and engaged in almost every variety of pursuit calculated to rupture the arterial tunics if they were in a serious state of disease, such as we so often meet with in the other sex.

2. VARIETIES OF ANEURISM.

True aneurism presents itself under two varieties of form, differing from each other materially in their appearance and mode of formation, although their essential symptoms and effects are usually perfectly similar, if not identical. These two varieties are the tubular and the sacciform, terms which are sufficiently expressive of their general conformation. Each consists of one or more of the arterial tunics, and forms a tumor, which, in time, is capable of exerting the most injurious effects upon the neighboring structures, and of causing the death of the patient.

The *sacciform variety*, fig. 240, is by far the more common of the two. It essentially consists, as the name denotes, in the formation of a pouch, bag, or sac, connected with the side of the affected artery. In the tubular variety the tumor is formed at the expense of the entire circumference of the vessel; in this, on the contrary, it occupies only a limited portion of it. The arteries which are most liable to suffer from sacciform aneurism are the aorta, particularly its thoracic division, the popliteal, femoral, innominate, carotid, and subclavian. The number of tumors is subject to considerable diversity; cases have been reported in which there were so many as to constitute a genuine aneurismal diathesis, nearly all the principal arteries in the body affording several examples of its occurrence. In general, however, there is only one, although others may form during its progress. Thus, it occasionally happens during the march of popliteal aneurism that an aneurism forms in the aorta, the carotid, or in the popliteal artery of the opposite side. The co-existence of aneurism in different parts of the body, and the tendency to its successive development deserve special attention on account of their practical relations; a subject to which allusion will again be made in another part of this chapter.

Fig. 240.

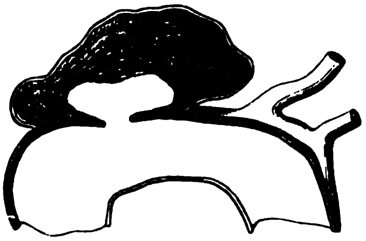


Sacculated aneurism. *a.* Artery; *b.* Aneurismal pouch.

The sacciform aneurism is capable of assuming a great variety of forms; the most common, however, is the globular, or ovoidal; in rare cases it is conical, elongated, or irregularly flattened, like a shot-pouch. Much diversity also obtains in regard to its dimensions; thus, while in some instances it is hardly the volume of a hazelnut, in others it is as large as the fist, or the head of the patient; in general, however, it does not exceed a hen's egg, or a medium sized orange. The largest aneurisms of this kind are usually found in the aorta and in the popliteal, iliac, and innominate arteries. The attachment of the tumor to the artery is commonly affected by a narrow footstalk; but cases occur in which it takes place by a broad and extended base, and, under such circumstances, it is not unusual for the artery to suffer serious compression during the progress of the disease.

The orifice of communication, fig. 241, between the sac and the artery varies in different preparations. When the tumor arises by a narrow footstalk the opening is usually proportionably small, with smooth and well-defined margins. When, on the other hand, it is attached by a broad base, the aperture is always much larger, and its edges are also more irregular, sometimes, indeed, quite shreddy and ragged, as if they had been torn. The situation of the orifice is commonly towards the centre of the sac, but it may be at one side, or even at one of its extremities. The form of the opening is extremely variable, and admits of no specific description. In the early stage of the disease, and in nearly all cases where the tumor is small, the orifice is of a rounded or circular configuration, while in cases of an opposite character it is generally more or less irregular. The internal and middle tunics may terminate abruptly at the margins of the opening of communication, or they may extend into the cavity of the sac, and thus serve to give it a partial lining.

Fig. 241.



Aneurism of the aorta; the greater part of the cyst being filled with clots, and the aperture of communication being small.

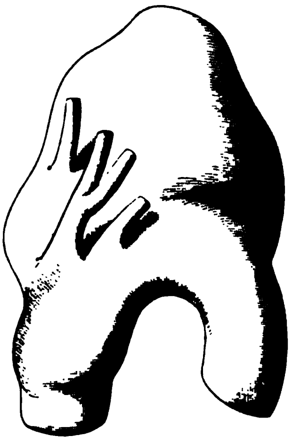
The composition of the sac is easily understood. For the most part it consists simply of the external tunic, the inner and middle having given way either prior to, or during, the development of the disease. The first thing, in fact, that usually happens, in all such cases, is the destruction, by ulceration or some other disorder, first, of the internal, and, soon after, of the middle layer of the artery, leaving thus a kind of crevice, which gradually enlarges under the influence of the impelling column of blood, and thus permits the corresponding portion of the vessel, now of course greatly weakened, to be converted into a pouch. This pouch, usually called the aneurismal sac, is originally, then, composed exclusively of the external coat of the affected vessel, the other strata terminating abruptly at the margin of the opening of communication, neither of them being prolonged into its interior. But this pouch would be very weak, and, consequently, ill adapted to withstand the shock of the blood as it rushes into its interior, if it were not strengthened by adventitious aid, derived from interstitial deposits in the surrounding cellular tissue. We accordingly find that nature, ever on the alert to save the part and system, is prompt in supplying the required relief by setting up inflammation and pouring out plastic matter, both in the substance of the sac and in the neighboring structures, thereby thoroughly gluing them together, at the same time that they are greatly increased in thickness and density, and thus enabled more effectually to resist the effects of the ever-beating, dashing, and tumultuous sanguineous current within. Such aid, then, is wise and needful, and, fortunately, always comes in play at an early stage of the disease, the laceration of the inner and middle tunics of the artery, and the pressure of the blood against the tumor, being sufficient causes of inflammation.

Although the sac is generally composed of the outer tunic alone, cases, nevertheless, occasionally occur where it consists, in the first instance, exclusively of the inner coat, the other two having given way. That such an arrangement is exceedingly infrequent, is proved by the fact that many surgeons of large experience have warmly contested the possibility of its existence. Haller and his cotemporaries, however, met with undoubted cases of it, and, in more recent times, it has been witnessed by Breschet, Dupuytren, and other observers, who have given particular descriptions of it. One ground for assuming that this form of aneurism cannot occur is, that it has never followed the numerous attempts that have been made to produce it in the inferior animals, by exposing the carotid artery and dissecting off its outer and middle tunics. In every experiment of this kind, the denuded membrane maintained its integrity, and the breach was speedily repaired by a free deposit of plastic matter. There is, however, no analogy between a sound and a diseased artery, and this fact should be borne in mind in the discussion of the subject. When the outer and middle tunics are destroyed by ulceration, as they always must be in such a case, not rapidly, but by slow degrees, it is not difficult to suppose that the inner membrane may, at the injured and weakened part of the vessel, be made to bulge across the opening, in the form of a thin, translucent cyst. Interstitial deposits would soon aid in strengthening the cyst, although ere long, and before it has acquired any considerable bulk, it would be obliged to yield to the resistless impulse of the blood within. Haller designated this form of aneurism by the term hernia of the inner coat of the arteries.

Cases in which the sac consists of the outer and inner coats of the artery, the middle having been destroyed, although also exceedingly infrequent, are more common than those in which it consists of the internal tunic alone. Such an arrangement is occasionally observed in aneurism of the carotid, femoral, and popliteal arteries; but, in time, the lining membrane is sure to give way, leaving thus the cyst composed of the outer coat and the surrounding tissues, as in the ordinary form of sacculated aneurism.

The thickness of the sac varies, in different cases and under different circumstances, from the fourth of a line to the fourth of an inch. Its consistence is often remarkably tough, and, in cases of long standing, it is generally composed of several distinct strata, of a grayish, whitish, or drab-colored aspect, consisting of fibres which intersect each other in every conceivable direction. The outer surface of the tumor is rough and shreddy; the internal, on the contrary, is smooth and polished, only, however, as a general rule, in its earlier stages, for in time it also becomes rough, and is finally incrusted with fibrinous matter. Notwithstanding the thickness of the aneurismal sac, and the efforts which nature makes to strengthen it, it gradually dilates, as in fig. 242, under the impulse of the inflowing column of blood, and at length, after the lapse perhaps of several months, manifests a disposition to yield at one or more points, very much as an abscess does, the activity of the absorbent vessels exceeding that of the capillary vessels.

Fig. 242.



Sacciform aneurism of the aorta ready to give way.

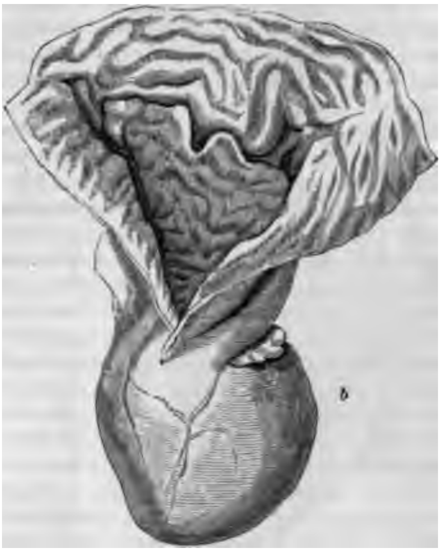
The sacciform aneurism always contains, even at an early period after its formation, *fibrinous concretions*, the presence of which constitutes one of its most interesting and important features, as they are evidently designed, not only to strengthen the tumor, but to aid in its obliteration, and, consequently, in the production of a permanent cure, although such an event is extremely rare. In their arrangement, these clots are always concentric, not unlike the layers of an onion, one being piled upon, and closely connected to, another. Their color and density vary according to the period of their formation, the older being usually of a pale, yellowish appearance, and of a firm, fibrous consistence, while such as are of a comparatively recent date, exhibit very much the aspect and consistence of a common heart clot. Their thickness ranges from the fourth of a line to that of a sheet of paper; and their number is often immense, thousands existing in a tumor perhaps not larger than an ordinary fist. That these concretions are organized, at least in many cases, is evinced by their intimate adhesion, not only to each other, but also to the inner surface of the sac, by their extraordinary density, and by their yellowish hue, which contrasts most strikingly with that of recently deposited fibrin and coagulated blood. These circumstances show that these lamellæ undergo most important changes after they have been deposited; that absorbent vessels are busily engaged in carrying away the serum and coloring matter of the blood, and in solidifying the fibrin after it has been extricated from the general mass; while the successive development of concretions clearly denotes that the process is as much a vital as a mechanical one. No one, I believe, has yet succeeded in demonstrating any vessels in these strata; but that they are always present, and often in great numbers, in cases of long standing, does not admit of any reasonable doubt. We may look upon these clots, then, as exceedingly interesting structures, capable, after a certain period, of maintaining a kind of independent existence, and whose primary object, in all cases, is to strengthen the aneurismal sac, and, under favorable circumstances, to fill it up, so as to effect a radical cure. What adds to the force of this conclusion is the fact that, when a cure of this description has been effected, the tumor is gradually brought under the influence of the absorbent vessels, by which it ultimately entirely disappears, with the exception, perhaps, of a little nodule, not larger than a pea, and just sufficient to indicate the former site of the disease. It is proper to observe that the recently-formed strata of an aneurismal sac are, in general, very imperfectly, if at all, organized; they are certainly not vascularized and furnished with absorbents.

How are these aneurismal concretions formed? Upon this subject there still exists some contrariety of sentiment. Most pathologists, however, suppose, and very correctly, as I think, that they are deposited from the blood as it sweeps over the inner surface of the sac, during which more or less of its fibrin is disengaged, while the other elements of the fluid are sent forward to mingle with the current in the affected artery. This opinion derives plausibility from the fact that the development of these strata always proceeds most rapidly when there is a comparatively small orifice of communication, with a languid state of the systemic and aneurismal circulation. It has been conjectured that the clots had their origin in an effusion of plastic matter, such as occurs in traumatic injuries and ordinary inflammation; but for such a view I can myself perceive no just ground, as it is impossible to discover the slightest similarity between the two processes. I have stated in the preceding paragraph that the act of formation is both a mechanical and a vital one; mechanical as far as the mere separation of the fibrin from the blood is concerned, and vital as it respects the decolorization, condensation, and intimate adhesion of the concretions.

The *tubular aneurism* is extremely rare; it is observed principally in the aorta, and the branches which are immediately detached from it, especially the innominate, carotid, and iliac, and consists in a uniform dilatation of the vessel, usually composed of all its tunics in varying degrees of alteration. In its shape, the tumor is commonly somewhat spindle-like, and hence it is often described under the name of fusiform aneurism; the term cylindroid has also been applied to it, as its conformation occasionally partakes strongly of that character. The word tubular, however, is more expressive of its appearance, and I therefore adopt it in preference to any other. The annexed drawing, fig. 243, from a specimen in my collection, affords a good idea of this variety of the disease.

The size of the tubular aneurism varies from slight increase of the normal diameter of the vessel to a tumor capable of receiving a large fist. When it occupies the arch of the aorta, it often projects up into the neck so as to form a prominent swelling above the sternum, admitting of satisfactory examination, both by touch and auscultation. The distance between the origins of the carotid arteries is greatly increased, and the aneurism generally encroaches sensibly upon the heart. In nearly every instance its length considerably exceeds its diameter. The dilatation of which it consists seldom terminates abruptly, but is usually lost by insensible degrees in the vessel above and below, thus giving the tumor the appearance of two cones united at their bases. In the smaller arteries, as, for example, the innominate, the aneurism sometimes involves the whole length of the vessel.

Fig. 243.



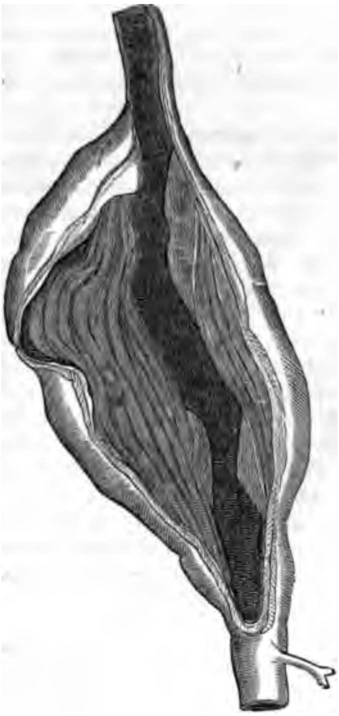
Tubular aneurism of the aorta. *a.* The aorta, much hypertrophied. *b.* The heart.

The structure of the tubular aneurism is usually made up of all the tunics of the affected artery, in a notable state of alteration, of which hypertrophy constitutes the most striking feature. In two remarkable specimens in my collection, the different tunics are immensely thickened, and increased in strength and density, the effect, evidently, of long-continued interstitial deposits; they both occupied the arch of the aorta, extending as far as the origin of that vessel, and were taken from male subjects upwards of fifty years of age. The lining membrane has lost its white and glossy appearance, and has been replaced by a thick, opaque, and rugose structure, having none of the properties of the original texture. The middle coat is at least ten times as thick as naturally, very strong, elastic, and deprived of its yellowish hue; the outer one is also greatly changed in its appearance, being remarkably strong, thick, and firm. No evidence whatever exists in any of the tunics of the earthy, atheromatous, or fatty degeneration.

From a careful examination of this form of aneurism, it appears to me to consist essentially in a dilatation of the caliber of the artery with hypertrophy of its different tunics. The first step, probably, in its formation is chronic inflammation, causing weakness of the walls of the vessel, and uniform enlargement of its diameter. By and by, however, as the dilatation increases, the coats become strengthened in every direction by interstitial deposits, and it is thus that a tumor is at length formed capable of offering great resistance to the impulse of the blood. It is owing to this superaddition of matter that the tubular aneurism so seldom gives way by rupture, a circumstance in which, as well as in several others, it differs remarkably from the sacciform variety of the disease.

It is not to be supposed, from what precedes, that this form of aneurism always consists of the different tunics of the affected artery; this is unquestionably true in most cases, but we now and then meet with an instance in which the lining membrane, and perhaps, also, the middle layer, are partially deficient, thus causing irregularity in the dilatation, unless, as occasionally happens, the defect is atoned for by plastic deposits. Indeed, the retention of all the tunics would seem to be an essential condition to the formation of the true tubular aneurism; if the inner and middle lamellæ be destroyed, even to a small extent, the blood will dilate the vessel unequally, and inevitably give rise to a sacculated tumor. It is in this way that we may explain the occasional coexistence of the two forms of the malady.

Fig. 244.



Aneurism, by dilatation. The abnormal space is almost entirely filled up by fibrin; the arterial canal remaining clear. Spontaneous cure exists in an advanced stage.

The tubular aneurism is remarkable, besides some of the characters already pointed out, for the absence of fibrinous concretions, which are so common in the sacciform; and the circumstance may be employed as an additional evidence of the correctness of the view, so long and so generally entertained, that the formation of these substances takes place directly from the circulating fluid, and not as an effect of the deposition of plastic matter, consequent upon inflammation, as some have conjectured. If the development took place in the latter way, it ought to be of frequent, if not of constant occurrence, inasmuch as the inner coat of the affected artery is seldom entirely free from inflammation, and would thus afford a large surface for the effusion of fibrin; but every one who has ever examined a specimen of tubular aneurism, knows how extremely rare it is to find its walls incrusted with anything. In the annexed sketch, fig. 244, from Hodgson, a tubular aneurism is seen occupied by concentric concretions, with a central canal, which preserved the continuity of the vessel, and thus permitted a continuance of the circulation. The stratification appears to have been very perfect.

3. SYMPTOMS OF ANEURISM.

The symptoms of aneurism exhibit, as might be supposed, much diversity, the principal circumstances which influence them being the nature, seat, and age of the tumor. Hence, in order to comprehend the subject thoroughly, it must be studied with special reference to these points.

In spontaneous aneurism, which usually depends upon rupture of the coats of the artery, the patient is often apprised of the commencement of the disease by the occurrence of a sharp pain, not unlike that produced by an electrical shock; he feels as if he had received a smart blow, and perhaps turns round to see who inflicted it. Occasionally, also, he is conscious of something having suddenly given way—he may even have heard a slight noise—and on examining the part a small pulsating tumor is found. Upon being interrogated as to the cause of the accident, he will usually state that it took place while he was engaged in some severe bodily exertion, as leaping, running, lifting, or coughing. But the origin of the disease is not generally thus marked; in the majority of cases, in fact, the patient has no distinct perception of its occurrence, and he is only apprised of its existence by degrees; not, perhaps, until it has already made serious progress. Such an event will be particularly apt to happen when the lesion consists essentially in a dilated condition of the arterial tunics, unattended with rupture, as it is then often extremely stealthy in its mode of invasion. In traumatic aneurism, on the contrary, the characteristic symptoms ordinarily show themselves immediately after the receipt of the injury of the vessel upon which the disease is situated.

The aneurismal tumor is usually quite small at its commencement, not exceeding, perhaps, the volume of a filbert, a small hickory-nut, or an almond; by degrees, however, it increases in size, and ultimately may acquire a bulk equal to that of a man's fist, or even of an adult's head. In its form it may be globular, elongated, ovoidal, conical, fusiform, or cylindrical; or so irregular as to defy description. However this may be, it is a living, beating tumor, rising and expanding synchronously with the contraction of the left ventricle of the heart. Its pulsations are often perceptible at the distance of a number of feet, especially in strong, plethoric subjects, and are always increased in force and frequency by whatever has a tendency to excite the general circulation. It imparts a distinct impulse to the hand, rising and falling as the blood enters and passes out; it is soft and elastic, and in its earlier stages permits itself to be emptied by steady and uniform pressure. Upon applying the ear to the tumor a peculiar noise is perceived, differing very much in its character and intensity. In general, it is a sort of sawing, rasping, or bellows sound, and so loud as to be heard with great distinctness at a distance of several inches; occasionally it is of a peculiar whizzing, whirring, or purring nature, and cases occur, although they are rare, in which it strongly resembles the buzzing of a fly in a bottle. The immediate cause of the sound is the manner in which the blood rushes into the tumor; its pitch is always greatest, other things being equal, when there is a comparatively small opening of communication, and when the sac, containing but little solid matter, is seated superficially.

The phenomena now described are, in general, susceptible of great modification by pressure applied to the artery above and below the tumor. In the former case, the size of the swelling is notably diminished and all motion and noise disappear; in the latter, it is sensibly augmented, the tumor heaves and rises under the resistance, and the blood, rushing violently against the inner surface of the sac, at each systole of the heart, produces great tumult, with a corresponding increase in the intensity of the different sounds. Considerable changes in the aneurismal sounds are sometimes occasioned by the rugose condition of the margins of the orifice of communication, and by partially detached clots, or projecting filaments, within the sac, intercepting the column of blood, and causing various murmurs and vibrations, together with a tremulous shaking of the tumor, isochronous with its pulsations.

The pain attendant upon aneurism is constant, but subject to variation in its intensity; slight early in the disease, and while the swelling is still small; more severe and harassing as it progresses and encroaches upon the surrounding parts. Diversified in its character, it is generally dull, aching, and throbbing, as if matter were about to form; in some cases it is sharp and darting, in others dull, heavy, or gnawing. Occasionally it is of a neuralgic nature, coming in fits and starts, or, as sometimes happens, in regular paroxysms, once or twice in the twenty-four hours. The immediate causes of the pain are, inflammation of the sac and the pressure of this upon the neighboring structures; hence it is always greatest, as a general rule, in large and old aneurisms, and in those parts of the body which are most abundantly supplied with nerves.

For the same reason that the pressure of the tumor causes pain, the distal parts usually suffer from numbness, and a sense of aching and weariness. Their temperature is diminished; and they are weak and crippled. Great swelling, of an œdematous character, is often present, the result, evidently, of the compression of the veins and lymphatics impeding the return of their contents. As the tumor enlarges, the distal portion of the artery contracts, and conveys less of its wonted supply to the lower parts. Gradually, however, this is compensated for by the collateral vessels, which, naturally existing, augment in size, and, in time, amply atone for the diminished stream in the main trunk. If it were not for this arrangement, the parts would soon shrivel and wither, or, worse, fall a prey to gangrene. Fortunately, such an event can only happen when the aneurism is of extraordinary bulk, or of very rapid development, thereby compressing also the collateral vessels and the principal nerves.

Aneurism of the thoracic aorta, and of the innominate and carotid arteries, is nearly always attended with distressing dyspnœa, severe pain, and palpitation of the heart, which is itself often seriously implicated in the disease, being especially liable to suffer from hypertrophy, softening, and fatty degeneration, along with chronic endocarditis and disorder of the tricuspid and semilunar valves. As the tumor enlarges, the respiratory difficulty rapidly increases, rendering walking painful, and the maintenance of the recumbent posture ultimately impossible. Compression of the trachea may induce asphyxia, and of the œsophagus, inanition. In the abdomen and pelvis, aneurism of the larger arteries, besides causing violent pain, may occasion serious functional disturbance, by interfering with the return of the blood in the vena cava, and thus leading to ascites and anasarca.

4. DIAGNOSIS OF ANEURISM.

Although the symptoms of aneurism are, in general, so well marked as to render it difficult to mistake their import, yet, as the disease may be simulated by other affections, and as doubts may thus arise in the mind of the inquirer concerning its true nature, it is necessary, in every case, however well-characterized it may apparently be, before he comes to a final decision, to institute a faithful examination into its history, progress, and present condition. It has been for the want of proper care in the investigation of this disease that some of the most serious and disgraceful blunders that disfigure the records of surgery have been committed; and, although such errors are now less frequent than they were formerly, owing to the more general use of the exploring needle, and a better acquaintance with pathological anatomy, yet it cannot be denied that what has occurred once may happen again, and that with tenfold effect, as it respects the character of the surgeon, who, to his skill as an operator, is always supposed to unite that of an enlightened diagnostician. The affections with which aneurism is most liable to be confounded are, chronic abscesses, glandular tumors, and encephaloid growths. Attention to the following circumstances will, if carefully remembered, enable the practitioner to avoid error.

1. Aneurism is always, from the first, seated in the direction of one of the larger arteries, whose course may often be distinctly traced by the finger; it is soft and elastic, pulsates more or less violently, is free from pain, and is unattended with discoloration of the integuments. Abscess, on the contrary, begins as a hard swelling, and becomes soft only after it has passed through its different stages; if chronic, matter will form very slowly, and, although it may surround the artery, and thus receive its impulse, yet the peculiar fluctuation of the swelling, and the changes that may be induced in it by pressure and posture, will always suffice to prevent error. In acute abscess,

there is severe pain, pus is poured out rapidly, and there is marked discoloration of the surface, with more or less constitutional disturbance. Glandular lymphatic swellings are most common in the neck, axilla, and groin in children and young persons of a strumous diathesis; they generally advance pretty rapidly, and, after having attained a certain bulk, either remain stationary, or alternately advance and recede; they are usually multiple, and not unfrequently occur simultaneously on both sides of the body. External aneurism, on the contrary, is most common in the popliteal, femoral, innominate, and carotid arteries, in middle-aged and elderly subjects, and, progressing slowly but steadily, never recedes, and rarely exists in more situations than one at the same time. Encephaloid growths occur at all periods of life and in nearly all regions of the body; soon acquire a large bulk; are of varying degrees of consistence, some parts being solid, some soft, and some semi-solid; are attended with great enlargement of the subcutaneous veins; and soon give rise to that pale and sallow state of the features known as the cancerous cachexia. Aneurism, as just stated, advances tardily, is of uniform consistence, especially in its earlier stages, is not accompanied by any enlargement of the subcutaneous veins, and, although the general health may seriously suffer, there is an entire absence of cancerous impress.

2. Aneurism pulsates the moment it is developed; no matter how small it may be, it throbs and heaves isochronously with the action of the heart, and possesses all the characteristic traits that distinguish it in its later stages, although they are perhaps less strongly marked. Abscesses and solid tumors, on the contrary, are seldom affected by the beating of the underlying vessel until they have acquired some bulk, and even then the impulse is often very faint, occurring rather as an undulatory movement than as a distinct shock.

3. In aneurism the tumor is generally firmly fixed, any attempt to grasp and lift it up proving abortive; possibly, it may be pushed gently to one side or the other, but this is all. Moreover, whatever changes may be effected in its relations none can be effected in its pulsations; it throbs and heaves as before. With solid growths this is not so; unless very large, they can be readily isolated from the vessel, and be thus deprived of all impulse, however strong.

4. The pulsation in aneurism is generally uniform, being perceived equally at every point of the circumference of the tumor, which rises and falls synchronously with the systole and diastole of the heart; in abscess and solid growths, on the other hand, it is very irregular, and is usually limited to a particular spot. In aneurism the swelling bounds and recedes under the hand; it feels as if it were alive and panting; in solid tumors the morbid mass rises at each impulse, but there are no expansion and contraction.

5. When an aneurism is firmly and uniformly compressed, it sensibly diminishes in bulk, which, however, recovers itself the moment the hand is removed; in solid growths and abscesses, pressure, however great, produces no such result.

6. In aneurism, the size of the swelling is diminished by pressure upon the cardiac side of the tumor, and increased by pressure upon the distal side. In morbid structures not aneurismal, no change of bulk follows this procedure.

7. The sounds of aneurism are different from those of solid tumors. Both may yield a sawing, bellows, or rasping noise, but in the latter this is never conjoined with the peculiar thrill, or whirring noise, which constitutes so prominent a symptom in the former.

8. Aneurism of the larger arteries ordinarily affords two alternate shocks, one of which corresponds with the diastole of the heart, the other with its systole. These phenomena are never present in solid tumors and abscesses, and are therefore pathognomonic.

Such are the distinguishing characters of aneurism and of the more important diseases with which it is liable to be confounded. It must be obvious, from what has been said respecting them, that mistake can only be avoided by the most rigid and thorough examination, made not once, but repeatedly, in every case of tumor situated along the course of an artery and influenced by its pulsation. Where, after such a pains-taking process, no satisfactory decision can be arrived at, our only resource is to insert a delicate exploring-needle, which, while it can do no possible harm, if it be properly employed, will at once determine the diagnosis.

5. EFFECTS AND TERMINATION.

The effects which aneurism exerts upon the surrounding parts vary according to circumstances, of which the most important are, the situation of the affected vessel, and the size of the tumor. An aneurism of the arch of the aorta will, other things being equal, produce more serious disturbance, both organic and functional, than one of the abdominal portion of that vessel, and an aneurism of the carotid artery than one of the popliteal. It is obvious also that a small tumor will, as a general rule, cause less serious effects than a large one.

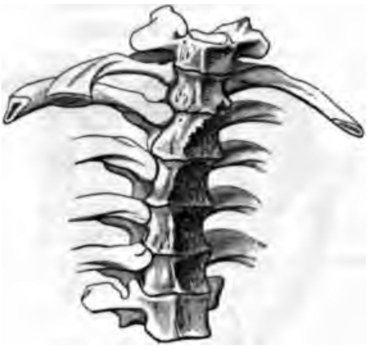
The effects which such a disease produces upon the parts with which it is in contact are purely of a mechanical character, eventuating in their displacement, compression, or ulceration, or in all these occurrences combined. An aneurism of the thoracic portion of the aorta must, necessarily, encroach more or less upon the contents of the chest, pushing the heart and lungs out of their natural position, and thereby interfering essentially with the performance of their proper functions. In aneurism of the carotid artery there will be displacement of the trachea, œsophagus, and the great vessels of the neck, along with compression of these parts, and also of the pneumogastric and sympathetic nerves. In popliteal aneurism the part of the limb below the site of the tumor generally suffers from obstructed circulation, as is evinced by the occurrence of anasarca and decrease of temperature, with a feeling of numbness, the result of interruption of the nervous current. When the embarrassment to the flow of blood is very great, or long continued, mortification of the distal portion of the limb is liable to ensue.

When the tumor is situated externally it may produce serious changes in the muscles, which, in many cases, are not only widely separated from each other, but remarkably pale, flattened, and attenuated, exhibiting more the appearance of thin ribbons than of thick, solid, fleshy bodies. The nerves, too, are often very much spread out, the vessels are thrust aside, and the aponeuroses are stretched out like tense sheets. When pressing upon an important joint, the tumor is sure to impede its motion, and may even cause permanent anchylosis, as occasionally happens in aneurism of the popliteal artery.

The effect produced by aneurism upon the osseous tissue is sometimes very remarkable, and is generally most conspicuously displayed in the dorsal portion of the spine. When the disease involves the thoracic aorta, the tumor, which often attains a large size, being crowded into a comparatively small space, is liable to encroach sadly upon the bony walls of the chest, pressing upon and eroding the bodies of the vertebræ behind, as seen in fig. 245, the sternum in front, the ribs at the side, and the clavicle above. There is hardly an osteological cabinet, of any extent, that does not afford striking evidence of the truth of this remark. I have seen specimens where as many as four of the bodies of the dorsal vertebræ were completely absorbed as far as the spinal canal, which, forming the posterior boundary of the tumor, was thus fully exposed to its pulsations. The sternum suffers mostly at its lateral and upper aspect, but occasionally, as in an instance now under my care, it is perforated at the centre, the movements of the aneurism being distinctly visible at that part. The ribs and their cartilages do not generally participate to any considerable extent in the erosion, and the clavicles are rarely affected, unless the tumor is of great bulk, and projects unusually high up into the neck.

It is not surprising, after what has been said respecting the effects which aneurism is capable of exerting upon the osseous tissue, that the tumor should occasionally cause serious lesion in the soft structures, apart from their mere compression. In its earlier stages, before the swelling has attained any considerable bulk, the inroads are slight, and, consequently, well borne, the parts manifesting no disposition to resent its encroachments; by and by, however, as it progresses, its pressure bears heavily upon the adjacent textures, which, taking on inflammatory action, become matted together by interstitial deposits, which, for a time, thus materially strengthen the aneurismal sac. But this state of things is not destined to last long; gradually the morbid action increases, the superincumbent tissues are more and more expanded, and, at length, ulceration setting in, the integuments yield over the more prominent portion of the sac, followed by destructive hemorrhage.

Fig. 245.



Erosion of the vertebræ from aneurism.

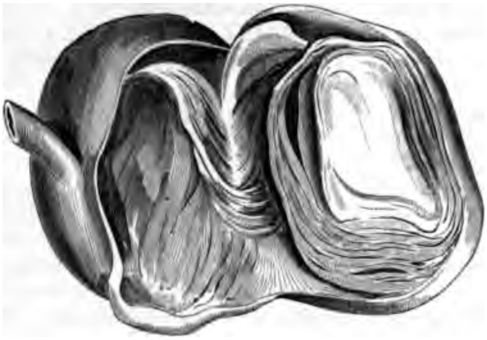
6. SPONTANEOUS CURE.

Unfavorable as the prognosis of aneurism generally is, it is extremely gratifying to know that a cure may occasionally be effected spontaneously, without the intervention of art in any way. That such an event is rare, forming merely an exception to the great law, is unfortunately too true; yet it sometimes occurs under circumstances apparently the most desperate, bidding defiance alike to medical and surgical skill. There are, indeed, few practitioners of enlarged experience, who have not met with cases of this disease in which, contrary to all calculations of the doctrine of chances, the patient made an excellent recovery, after having literally hovered, for days and weeks, over the very verge of the grave; where, in short, everything portended speedy destruction, and yet every vestige of the aneurism ultimately disappeared, the person living for years afterwards in the enjoyment of good health, and in the exercise of his former occupation. How the cure is effected in these cases, our information does not enable us to explain, as an opportunity is seldom afforded of making a dissection of the body after the event has taken place, in consequence of the individual being usually lost sight of. A knowledge, however, of the possibility of such a cure is highly encouraging, and holds out the hope that it may be of more frequent occurrence than has hitherto been imagined.

Although we are not always able to account for the manner in which the patient gets well in this disease, yet observation has demonstrated that it generally occurs in one of five ways, all leading, essentially, to the same result, namely, the formation of clots, by which not only the aneurismal sac is closed up, but also the artery immediately above and below it. When the cure is gradual, the clots are usually arranged concentrically, and exhibit every mark of organization; but the reverse is the case when it is effected suddenly, for then they are nothing but soft, red blood-masses, similar to what we so often observe after death in the heart and large vessels.

1. The most common way in which the cure takes place is by the gradual filling up of the sac by the formation of clots, thereby ultimately converting it into a firm, solid tumor. The most beautiful and perfect specimen of this kind, represented in fig. 246, that I have ever seen, was presented to me, some years ago, by an old pupil, Dr. Shumard, who had removed it from the body of a young steer. What renders it still more interesting, is the circumstance that it was connected with the hepatic artery, which had given way at one side from the rupture, apparently, of its inner and middle tunics. The tumor, which is of a rounded shape, and nearly three inches in diameter, is occupied by hundreds of lamellæ, many of them not thicker than a sheet of paper, of a pale grayish color, closely adherent to each other, concentrically arranged, of a dense, firm texture, and, beyond question, thoroughly organized, even those most recently deposited. At the centre of the tumor, a small irregular cavity exists, which still admitted some blood, as is proved by the fact that the hepatic artery is completely pervious. This mode of reparation is greatly facilitated by the small size of the opening of communication between the artery and the aneurismal sac.

Fig. 246.



An aneurismal tumor obliterated by the deposition and organization of fibrin.

2. Another mode of spontaneous cure is the occurrence of inflammation, followed by the coagulation of the contents of the sac, and the ultimate obliteration of its cavity as well as of the artery in its immediate vicinity. The disease may begin in the tumor itself, or be propagated to it from the circumjacent structures; if it be mild and slow, the cure may be easy and safe, but if it be very active, it may terminate in suppuration, and thus endanger life by hemorrhage, the matter being evacuated along with the clots before the artery is hermetically sealed by an internal coagulum.

3. The reparation occasionally occurs through the intervention of gangrene, either beginning in the tumor itself, or extending to it from the parts immediately around it. The blood coagulates in the sac as it does in an artery in ordinary gangrene, and when the sloughs separate the clots are discharged, the gap being afterwards closed by the granulating process. Such a mode of restoration must necessarily be infrequent, inasmuch as the morbid action by which it is effected generally terminates fatally.

4. The contents of an aneurism are sometimes solidified by the compression of the artery leading to it, caused either by the tumor itself or by some morbid growth in its immediate vicinity. Such a result may follow with nearly equal certainty, whether the pressure be applied to the cardiac or to the distal portion of the vessel.

5. Finally, a very rare mode of spontaneous obliteration may take place, consisting in the detachment of a small clot and its introduction into the distal portion of the artery, thereby more or less completely blocking it up. The blood, being thus checked in its onward flow, soon coagulates, just as it does in artificial compression. It was upon a knowledge of this species of

spontaneous cure that Mr. Fergusson recently attempted to found a new mode of treatment of aneurism by breaking up the contents of the tumor by manipulation, and thus urging them on into the communicating vessel.

When, by any of the above modes, a radical cure is effected, the tumor is gradually brought under the influence of the absorbent vessels, and is ultimately completely obliterated, or, at all events, so far reduced as to leave only a small nodule, indicative of the former site of the disease. The period required for the perfection of these changes varies from three or four weeks to as many months, according to the size of the aneurism and the state of the part and system.

Although an aneurism may, as we have just seen, occasionally get well by the unassisted efforts of nature, yet such an event forms merely an exception to a great law, in conformity to which the disease almost uniformly proves fatal. The period at, and the mode in, which this takes place vary in different cases and under different circumstances, and can, therefore, be pointed out only in a general manner. In aneurism of the aorta, especially in the arch of this vessel, the disease often produces death in less than three months from its commencement; in the innominate its course is also generally rather rapid, and a similar remark applies to aneurism of the primitive iliac; in aneurism, on the contrary, of the carotid, subclavian, axillary, external iliac, femoral, and popliteal arteries, the fatal event is often postponed several months longer. To these statements there are, of course, many exceptions; thus, on the one hand, we occasionally meet with an aneurism which ends fatally in a few weeks, the tumor expanding rapidly, and perhaps bursting quite suddenly during a violent muscular effort; and, on the other hand, the disease may continue, with very little variation, as to size, for a number of years.

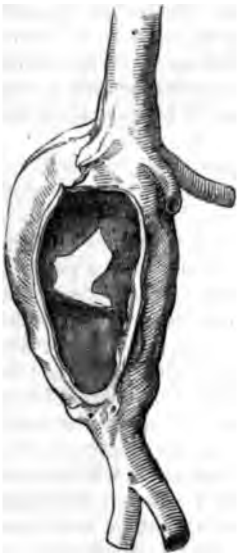
There are three distinct modes by which aneurism may cause death: 1. By the injurious compression which the tumor exerts upon the neighboring organs. 2. By the sudden rupture of the sac, and the occurrence of hemorrhage. 3. By the development of inflammation, suppuration, or mortification.

1. Aneurismal tumors of the neck and chest often cause death by compression of the trachea and bronchial tubes, although perhaps not as frequently as has been generally supposed, owing to the wonderful power which these tubes possess of flattening themselves, so as to make room for the entrance of the air into the lungs. Indeed, I am inclined to think, from my knowledge of this subject, that death from direct suffocation, from this cause, is an uncommon event. Great difficulty is often produced by the pressure of the sac upon the pneumogastric and phrenic nerves, and it is extremely probable that life is sometimes destroyed in this way, the more especially if the pressure be conjoined with serious lesion of the air-passages. Finally, death occasionally proceeds from compression of the heart and lungs, interfering with the circulation and respiration; or from compression of the œsophagus, causing inanition. In the abdominal and pelvic cavities, and also in the extremities, the danger from compression is much less, as the structures here are less important to life, as well as more disposed to yield under the encroachment of the tumor.

2. After an aneurismal tumor has attained a certain bulk it is extremely apt to give way, as in fig. 247, either suddenly or gradually, under the impulse of the blood, or under severe muscular exertion. Such an occurrence will be the more likely to happen when the tumor has been of rapid growth, and especially if its interior has not been fortified by the formation of hard, organized clots, so as to increase the thickness and strength of its tunics. It is in this manner that most of the internal aneurisms, which do not cause destruction by mere compression, ultimately terminate, the immediate cause

of death being hemorrhage into some internal and contiguous organ. Thus, in the chest, the tumor usually opens into the trachea, the bronchial tubes, the pleura, pericardium, mediastinum, or œsophagus. Sometimes a communication is established between the sac and the heart, between it and the pulmonary artery, or, lastly, between it and the vena cava. An aortic aneurism has also been known to burst into the spinal canal, some of the bodies of the vertebræ having previously been destroyed by absorption. In the abdomen, the tumor may break into the peritoneal cavity, or into one of the hollow viscera, as the stomach, intestine, or urinary bladder. In the neck, axilla, groin, and extremities, the aneurism, if permitted to pursue its course, generally finds its way to the surface, very much after the manner of an abscess.

Fig. 247.



Aneurism of the descending aorta, burst, the patient dying suddenly in consequence.

The hemorrhage succeeding to the rupture of an aneurism may be slight, as when the aperture is small or devious, or copious and destructive, as when the opening is large or straight. Most commonly, life is worn out by the frequent recurrence of the bleeding; thus, twenty ounces of blood may be lost to-day, in a week twenty or thirty ounces more, and so on until the patient dies completely exhausted, his condition being, in the meantime, perhaps seriously aggravated by serous effusions into some important cavity. Occasionally the aneurism gives way by a large rent, and the patient expires instantly in consequence of the hemorrhage.

3. More or less inflammation attends all aneurisms; whatever may be their volume or situation, their age, or character, they play the parts of intruders, encroaching upon, compressing, and irritating the surrounding structures, and thus giving rise to various deposits, especially of serum and plasma. It is by means of the latter that, as was previously stated, the sac increases in thickness and density, so as to qualify it the better to bear with impunity the impulse of the inflowing current of blood; without such an occurrence few tumors of this kind would be able to maintain themselves for any length of time, but would soon yield to the resistless pressure from within; in a word, speedy rupture of the sac, and fatal hemorrhage would, in most cases, be inevitable. But, although inflammation is set up for wise and beneficial purposes, the process, unfortunately, is not always kept within the strict limits required to fortify the sac and protect it against early rupture; on the contrary, many circumstances occur to provoke its increase, and to cause it to pass into ulceration, suppuration, and even mortification. Among these circumstances some are of a constitutional, and others of a purely local character; thus, mere plethora and the use of stimulating food and drink may powerfully augment the inflammation, and bring about these untoward results. In general, however, it will be found that the mechanical compression of the tumor, in consequence of the resistance offered to its extension, has more to do with its production than anything else. Sometimes a clot is accidentally detached, and thus becomes a cause of mischief. In external aneurism, the manipulation employed in examining the tumor is occasionally productive of severe inflammation, and similar effects often follow the injudicious use of the affected limb.

Suppuration of the tumor is an infrequent event. A case occurred in 1857, at the Pennsylvania Hospital, in the service of Dr. Pepper, in which an abscess had formed in connection with an aneurism of the innominate, and killed the patient, a man aged 38, by bursting into the trachea. A report, with a drawing of the case, has been published by Dr. Humphreys, in the Transactions of the Pathological Society of Philadelphia. Ulceration and mortification are more common, and are particularly liable to take place when the tumor is of large size.

Finally, aneurism may prove fatal by exciting inflammation in an important internal organ, as the lung, heart, or pleura. In popliteal aneurism, the pressure of the tumor upon the nerves and arteries below sometimes causes death from mortification of the leg and foot.

TREATMENT.

Notwithstanding the vast amount of attention that has been bestowed upon aneurism, from the earliest periods of medical science down to the present, it may truly be affirmed that there is no subject connected with practical surgery which has been so little understood by the great mass of the profession as this. This circumstance has arisen, it seems to me, not so much from a want of ability on the part of the practitioner to comprehend the nature of this lesion, as from the obscure and imperfect manner in which it is usually discussed in our lecture-rooms and in our systematic treatises. Much difficulty also has grown out of the defective nomenclature of aneurism and of the ambiguity which, until recently, existed in regard to the pathology of this affection, both tending to give rise to erroneous ideas of practice. Light, however, is gradually breaking in upon us; and it is highly probable that the advances of modern science will enable us, ere long, to treat aneurism with as much confidence as any other class of maladies.

Leaving, for the present, out of view the treatment of internal aneurism, as belonging as much to the department of medicine as that of surgery, I shall proceed to consider the various remedies that have been proposed for the cure of the external form of the disease, or, more properly speaking, of those cases of aneurism which are more directly and immediately amenable to the art and science of surgery. In doing this, it will be necessary to bear in mind the divisions of aneurism pointed out in the commencement of the section, as each of them will require corresponding modifications of management.

In the time of Celsus, as well as for a long period subsequently, the treatment of aneurism was conducted in the most cruel and unscientific manner. The only operation which appears to have been known was to lay open the tumor by a bold incision, and, after turning out its contents, to apply the hot iron to the extremities of the affected artery, so as to seal up their mouths. The effect of such a procedure may easily be imagined; upon the separation of the eschar, hemorrhage was sure to take place, and in this way nearly every patient perished, either at the first onset of the bleeding, or by its frequent repetition. This miserable practice continued in vogue until the introduction of the ligature by Ambrose Paré. A different mode of procedure was now adopted, although it can hardly be said to have been much of an improvement upon the one just described. It certainly, however, possessed the advantage of being more scientific, and of being less frequently followed by hemorrhage, notwithstanding it could claim little on the score of simplicity as far as its execution was concerned. It consisted in ligating the artery above and below the tumor, which was then freely opened, thoroughly cleared out, and stuffed with charpie, to promote suppuration and occlusion, the object being to heal the wound from the bottom. Occasionally the more adventurous surgeon took the more speedy route of extirpating the tumor, adopting a plan similar to that which is sometimes pursued at the present day in treating aneurism at the bend of the arm consequent upon venesection. The result of this operation, too, was often most disastrous; many of the patients died of the effects of inflammation, some of secondary hemorrhage, and not a few of the shock of the amputation performed as a *dernier ressort*, to save them from impending destruction. To prevent these sad occurrences, and afford the sufferer a better chance of recovery, the removal of the limb was often the only operation thought of for his relief.

a. DELIGATION OF THE ARTERY AT THE CARDIAC SIDE OF THE TUMOR.

It is amazing to think that some of the operations above described should have continued in vogue until near the close of the last century. The fact attests, more fully than any other circumstance with which we are acquainted, the low state of surgery up to that period. The merit of performing the first operation for the cure of aneurism upon strictly scientific principles is due to Mr. John Hunter, who flourished in the latter part of that century, and whose labors have shed so much lustre upon the healing art. From having witnessed so many failures from the ordinary procedure, he was led to the conclusion that the cause consisted in the fact that the artery was always diseased for some distance above the aneurism, and that it was, therefore, incapable of becoming sufficiently occluded prior to the detachment of the ligature to prevent hemorrhage. Acting under this conviction, amply confirmed by dissection and observation, he determined, upon the first favorable opportunity, to apply the ligature upon a sound portion of the vessel. While thus revolving the matter in his mind, a man, laboring under popliteal aneurism, was admitted into St. George's Hospital, of which he was then one of the surgeons. The patient was a coachman, forty-five years of age, and the tumor, first perceived three years previously, was not only quite large, but was attended with great swelling of the foot and leg. The operation was executed in December, 1785, the femoral artery being exposed a little below its middle, and surrounded by four ligatures drawn so gently as simply to bring the sides of the vessel together. "The reason for having four ligatures was," as is stated by Sir Everard Home, by whom the case was reported, "to compress such a length of artery as might make up for the want of tightness, it being wished to avoid great pressure on the vessel at any one part. The ends of the ligature were carried directly out of the wound, the sides of which were now brought together and supported by sticking-plaster and a linen roller, that they might unite by the first intention."

It is unnecessary to enter into any details respecting the after-treatment of the case. It will be sufficient for my purpose to state that on the second day after the operation the tumor had lost more than one-third of its original bulk; that the ligatures, some of which came away on the fifteenth day, excited severe inflammation in the artery, as well as in the surrounding parts; and that the man left the hospital on the 8th of July following, in good health, and with no appearance of any tumor in the ham. He subsequently resumed his former occupation as coachman, and died from an attack of remittent fever, fifteen months after the operation. The limb being dissected, the femoral artery was found to be impervious as high up as the profunda, while below the site of the ligatures, as far down as the tumor, it was open, and contained blood, except just where it entered the aneurism, where it had become obliterated. The sac was a little larger than a hen's egg, but more oblong and flattened, and contained a solid coagulum adherent to its internal surface.

I have been induced to give a brief outline of this case for two reasons. In the first place it deserves to be commemorated because it embodies the application of a new principle to the cure of a disease which, until then, was almost uniformly fatal; and, secondly, because it will enable us to establish, in a more satisfactory manner than we could otherwise do, the claims of Mr. Hunter to the credit of having originated the operation, which has been so sturdily denied him by the French surgeons, who have, almost with general consent, ascribed it to their countryman, Dominic Anel. I have no disposition to enter into the merits of this dispute, especially at this remote period, when everything relative to it should be fully understood; I shall, therefore, content myself with a recital of a few of the more prominent and important facts of Anel's operation, for these will be sufficient to show that it differs wholly and entirely from that of Mr. Hunter, and that, so far from involving any new principle, it was merely a simplification of the old procedure.

The case of Anel, to whom surgery is indebted for some of its most valuable improvements, fell accidentally into his hands during a visit which he made to Rome in 1710. His patient was a Catholic priest, who, in consequence of having had the brachial artery pricked in venesection, was affected with an aneurism at the bend of the arm; the tumor was large, and, being the seat of slight ulceration, seemed to have been on the point of bursting. Having controlled the circulation in the limb by means of the tourniquet, he cut cautiously down upon the artery, and, after separating it from the accompanying nerve, he raised it upon a hook, and tied it as near to the tumor as possible. All pulsation in the tumor instantly ceased, the ligature came away on the eighteenth day, and at the end of a month the friar was able to use his arm quite as well as before the accident.

It will thus be perceived that the operations of the English and French surgeons differed from each other in every particular; and it is only surprising that there ever should have existed any contrariety of opinion respecting them. The procedure of Anel was executed for the cure of a traumatic aneurism; the artery was perfectly healthy, and it was tied in as close proximity to the tumor as possible, the Frenchman never supposing that he was about to establish a new principle in operative surgery; he nowhere alludes to such an intention, and his only object seems to have been to afford his patient, who was suffering great agony, and who might bleed to death at any moment from the sudden bursting of his tumor, prompt relief. The Englishman, on the contrary, had studied the subject with infinite care and attention; he had made numerous dissections and even performed some experiments upon the inferior animals, as the dog and horse, with a view of ascertaining the condition of the artery in aneurism and its ability to bear the ligature; and he had clearly perceived that, as the cause of failure of the old operation was that the ligation was always made too near to the tumor, the only safety would be to tie a sound portion of the vessel, even although this should be at a very considerable distance from the aneurism. His object was not to cut off the supply of blood at once, but simply to weaken its passage through the tumor, thereby giving its contents an opportunity of undergoing gradual coagulation, and at the same time preventing the distal parts of the limb from perishing from the sudden stoppage of the circulation. The result of the case above detailed proved the correctness of his reasoning, and established, upon a firm and immutable basis, what is now universally recognized in Great Britain and in this country, as the Hunterian operation for aneurism.

The operation of Hunter has been performed upon almost every artery of the body liable to suffer from aneurism. Even the aorta itself has been repeatedly tied, and, although the cases have all proved fatal, yet the result has been such as to show, most conclusively, that the event has been due much more to the injury inflicted upon the surrounding structures than to the violence done to the circulation by cutting off so great a quantity of blood from its accustomed channels. Great simplicity now char
a healthy portion of artery is selected, great ca

vessel, to disturb its sheath as little as possible, and only one ligature is used, but that is drawn so tightly as to lacerate the inner and middle tunics, when, a double knot being made, one extremity is cut off, and the other is brought out at the nearest point of the wound, which is then treated in the ordinary manner. Cessation of pulsation usually occurs at once upon tightening the ligature, although not necessarily so; sometimes, indeed, several days elapse before it is fully established, but even then it is commonly very much diminished in force, thus paving the way for the formation of clots upon which the cure ultimately depends. The persistence of the circulation, after the main artery of a limb has been ligated, arises from the anastomosing branches continuing to pour their contents into that portion of the vessel which lies between the cord and the sac, as well as into the sac itself, and perhaps also into the distal portion of the artery. When these branches are inordinately large, or numerous, they may keep up such a supply of blood as to compromise effectually the success of the operation.

The operation is generally followed by a slight diminution of temperature in the limb, but this rarely lasts beyond a few hours, when it is succeeded by a marked increase of heat, owing to the augmented activity of the cutaneous circulation, in consequence of the blood being forced principally through the superficial capillaries. Subsequently, however, as the anastomotic branches enlarge, and the circulation becomes equalized, the temperature sinks again, and now perhaps somewhat below the normal standard, the parts really feeling, for the first time, the loss of blood occasioned by the ligation of the artery. In not a few cases the limb retains its temperature after the operation with hardly any variation, as if nothing at all had happened.

Instead of the ordinary silk ligature, Dr. Stone, of New Orleans, in a case of aneurism, in 1859, tied the common iliac artery with a silver wire, simply approximating the sides of the vessel, and leaving the wire in the wound, convinced of its entire harmlessness. The patient died on the twenty-sixth day, but, as no autopsy was made, the disposition of the ligature was not ascertained. At my College Clinic, last June, I secured, in a similar manner, the femoral artery in a case of popliteal aneurism; the patient rapidly recovered without any untoward symptom, and the wire still remains in the thigh, nearly the entire wound having healed by the first intention.

After-treatment.—The treatment after the operation must be conducted with great judgment and attention. The patient being carried to bed, the limb is placed in an easy and relaxed position, but not elevated, lest arterial influx be interfered with; and it is well, especially if there be a diminution of temperature, that it should be enveloped for some time in wadding. Cold applications must be carefully avoided, even if the skin manifest inordinate heat with some degree of swelling, as they could not fail to be prejudicial by lowering the vital powers, and so laying the foundation for mortification. A full anodyne should be administered immediately after the operation, to tranquillize the action of the heart; light diet is to be observed, with cooling drinks; and the temperature of the apartment is not permitted to exceed 65° of Fahrenheit. The bowels must not be opened for several days, and then only by the mildest laxatives, drastic purgatives being particularly objectionable on account of their tendency to cause excitement and throbbing of the arteries; occurrences which would inevitably be injurious after such an operation.

Causes of Failure.—The causes of failure after the Hunterian operation are, first, violent inflammation, followed by mortification; secondly, death of the limb from deficiency of blood; thirdly, secondary hemorrhage, either from premature detachment of the ligature, or rupture of the sac; and, fourthly, maintenance of the circulation by means of a redundant anastomosis. None of these accidents, save the last, and that is a very improbable one, will be likely to happen if the part and system have been thoroughly prepared for the operation, if the disease has not made too much progress, and, finally, if proper care and judgment be employed in managing the case after the application of the ligature. Deligation of the carotid arteries for the cure of aneurism is liable to be followed by inflammation of the brain and lungs, with softening of the former of these organs and hepatization of the latter. Much of the mortality from the operation is caused by this disease.

No recent statistics of the Hunterian operation, on a large scale, have appeared. The most satisfactory, so far as I know, are those of Mr. Thomas Inman, of Liverpool, published in 1844. His table was made up of all the reliable cases that had been recorded up to that period in the various medical and surgical periodicals.

Name of the artery.	No. of cases.	Deaths.	Proportion.
Innominate artery	6	6	...
Subclavian artery	40	18	1 in 2
Carotid artery	40	11	1 in 4
Abdominal aorta	3	3	...
Common iliac	8	3	1 in 2⅔
Internal iliac	4	2	1 in 2
External iliac	27	9	1 in 3
Femoral	42	7	1 in 6
Total	170	59	1 in 3

b. DELIGATION OF THE ARTERY AT THE DISTAL SIDE OF THE TUMOR.

It is well known that aneurism occasionally occurs so near the trunk as to render it impracticable to perform the Hunterian operation, or that the artery, although accessible at the cardiac side of the tumor, is too much diseased to enable it to support the ligature. Mons. Brasdor, a professor in the old school of surgery at Paris, upwards of seventy years ago, after much reflection upon the subject, arrived at the conclusion that gradual and efficient coagulation of the blood in the aneurism might be produced by placing the cord upon the artery at its distal aspect. He had no opportunity, however, of solving the problem upon the human subject. The merit of this was reserved for Deschamps, although the case upon which he tried it could hardly have been worse for such an undertaking. The patient, besides being old, was worn out by suffering, and the tumor, which occupied the upper part of the thigh, extending to within a short distance of Poupart's ligament, was nearly seventeen inches in circumference. The operation was tedious and difficult, on account of the depth of the artery and the absence of pulsation, but the vessel was at length discovered and effectually secured. Contrary, however, to expectation, the aneurism, which had made marked progress for some time previously, now rapidly increased in volume, and on the fourth day, when it appeared to be on the point of bursting, it was resolved to perform the ordinary operation, notwithstanding the reasons which had just before been urged against its adoption. Two ligatures were applied, but the operation was attended with copious hemorrhage, and the man died in eight hours after.

The operation of Brasdor was next performed by Sir Astley Cooper, in a case of aneurism of the external iliac artery, extending so high up into the abdomen as to render it impossible to place a ligature between it and the heart. The femoral artery was, therefore, tied a short distance below Poupart's ligament, between the epigastric and profunda. The patient did well for some days, when the tumor, which had been gradually diminishing in volume, burst, causing death by hemorrhage.

What the results of these two attempts might have been, if the cases had been of a more favorable character, is a matter which must, of course, be left to conjecture. It is certain, however, that no attempt was made to repeat the operation until 1825, when, almost forgotten by the profession, it was performed by the late Mr. James Wardrop, of London, in a case of aneurism of the carotid artery. The success was complete. The ligation was followed by an immediate diminution of the tumor, which gradually progressed until, at the end of the fifth week, the neck had nearly regained its natural form; the ligature had dropped off, and the general health was entirely re-established. The patient, a woman, aged seventy-five, continued to be perfectly well three years after the operation.

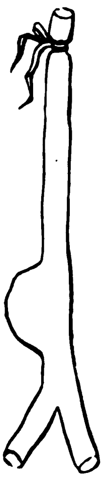
Having been equally successful in several other cases, Mr. Wardrop was induced to extend the principle of Brasdor's operation to aneurism of the innominate artery. It occurred to him that, by tying one of the branches of this artery, the force of the circulation might be so far diminished in the tumor below as to cause the solidification of its contents; and a favorable opportunity soon after arising, he was not slow in putting his ideas in practice. The patient, a female, aged forty-five, had a pulsating swelling, of the size of a turkey's egg, in the inferior part of the neck, its base being concealed by the sternum, and evidently connected with the innominate artery. For the cure of this disease the right subclavian was tied in July, 1827, with the effect of a gradual amelioration of the distressing symptoms, and the ultimate disappearance of the tumor, its site being occupied merely by an unnatural hardness, the result, probably, of the remains of the aneurism. This was the condition of the patient fourteen months afterwards, at which time the carotid artery still pulsated, although not so vigorously as the left, and the woman was in better health than she had been for a long time.

The procedure now described constitutes what is called Wardrop's operation, although it is in reality, as was before intimated, merely an extension of that of Brasdor; and is only applicable to aneurism of the innominate artery. It has been performed within the last fifteen years in a considerable number of cases, generally by tying the common carotid; but the results have, for the most part, been unfavorable, owing, as has been alleged, and as is probably the fact, to the occurrence of violent inflammation both in the aneurismal sac and in the vessels in immediate communication with it, terminating fatally in a few days, or, at most, in a few weeks.

Deligation of the artery at the distal side of the sac has hitherto been most disastrous. Thus, of 27 cases, collected by Mr. Erichsen, death speedily occurred in 20, while in the remaining seven, although the patients escaped with their lives, no benefit whatever resulted in regard to the cure of the aneurism.

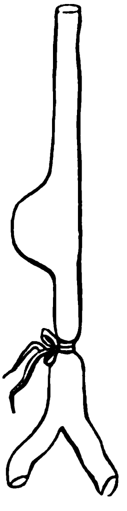
The annexed cuts afford an illustration of the various methods of ligating arteries for the cure of aneurism, above described. A glance will serve to show how inefficient such an operation must be when performed according to the plan suggested by Mr. Wardrop.

Fig. 248.



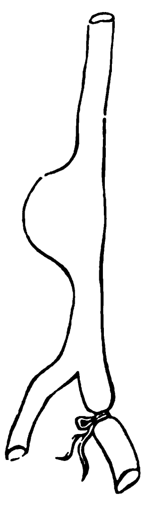
Hunter's.

Fig. 249.



Brasdor's.

Fig. 250.



Wardrop's.

C. INSTRUMENTAL COMPRESSION.

The treatment of aneurism by compression dates back to a very early period of the profession, and, although the principles upon which it was formerly conducted were far from being scientific, numerous cases have been published illustrative of its efficacy. It is not my design to inquire into the history of the operation, or to seek out its inventor for the purpose of awarding him praise for his ingenuity and enterprise; it is sufficient to state that the compression was originally applied directly to the tumor, or to the tumor and the limb upon which it was situated, either by means of an apparatus specially constructed for the object, or by a compress and roller, extended from the distal portion of the extremity upwards, beyond the seat of the disease. The practice was most frequently employed for the relief of traumatic aneurism, especially that form of it consequent upon injury of the brachial artery, at the bend of the arm, and, although it proved occasionally successful, not a few cases occurred in which it was followed by violent inflammation of the sac and limb, eventuating in ulceration, abscess, or gangrene.

In the latter part of the last century, Vernet, a French military surgeon, conceived the idea of curing aneurism by applying compression upon the artery immediately beyond the tumor, upon the same principle as that upon which Brasdor soon afterwards suggested the use of the ligature. He thought that the operation was particularly adapted to aneurism situated so near to the trunk as to forbid a resort to the ligature, or compression upon the cardiac side of the swelling. It would appear, however, that he practised it only in one instance—upon a man affected with inguinal aneurism—and that so great was the disturbance which it created in the pulsations of the sac, that he was obliged, in a very short time, to abandon it. From the want of success attending the case, ill adapted as it was to test the principles of a new process, no one, it seems, felt afterwards disposed to make further trial of it, and it was accordingly forgotten, or remembered only as an ingenious suggestion.

Compression of the artery above the tumor, or between it and the heart, was first distinctly insisted upon as a remedy for the cure of this disease, by the late Mr. Freer, of England, in his observations on aneurism, published early in the present century. In the work here referred to, he gives particular directions for applying the compression, enjoining that it should be made by enveloping the whole limb with a bandage, and placing upon the vessel, in the most superficial portion of its extent, a small pad, which was then to be screwed down by means of a tourniquet. To render its action more effective, a plate was secured to the opposite side of the limb, which, while it defended the integuments and muscles from injurious constriction, concentrated the force upon the particular point of the artery where it seemed to be most needed. Notwithstanding this precaution, the application of the tourniquet was soon followed by pain and œdema of the extremity, generally so violent as speedily to necessitate its removal. Short, however, as the compression was, it occasionally laid the foundation of a cure, which was afterwards perfected by the steady but cautious use of the ordinary compress and bandage.

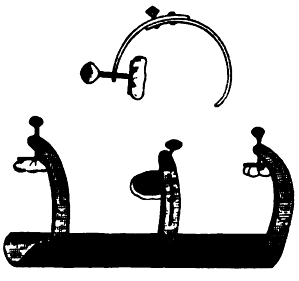
Acting upon the suggestions of Freer, Dupuytren and others applied themselves to this mode of curing aneurism, devising useful and ingenious instruments as substitutes for the more clumsy contrivance above described. The French surgeon, in particular, invented a most admirable compressor, at once simple and efficient, which still bears his name, and which he employed successfully in several cases of aneurism of the inferior extremity. The cures, however, that were effected in this way were few compared with the great number of failures, and the consequence was that the treatment never met with much favor. What added to the dissatisfaction of practitioners was that, in quite a considerable number of cases, it was followed by results highly prejudicial to the limb, if not to both limb and life.

Thus stood the treatment of aneurism by compression, when, in 1843, it was destined to experience a complete revolution in the hands of several eminent surgeons of Dublin, particularly Hutton and Bellingham, the latter of whom, in a short tract upon the subject, was the first to point out, upon correct and scientific principles, the manner in which it acts in curing the disease. Prior to this period, one replete with interest to the progress of surgery and humanity, compression was a very painful and hap-hazard proceeding, conducted without any discrimination and judgment, and, consequently, without any certainty as to its results. The idea was that, in order to succeed, it was necessary that it should be applied firmly and steadily, so as to arrest the circulation, and cause adhesion of the sides of the artery, very much as in the operation of ligation. Hence the poor patient was generally subjected to immense torture, often compelling the speedy discontinuance of the treatment, which, however, notwithstanding this, was occasionally followed by the worst consequences, as manifested in the violent swelling of the affected limb, and perhaps its ultimate loss by gangrene. The procedure was altogether a blind one, and, therefore, just as likely to prove prejudicial as useful. It was employed by one practitioner simply because it had occasionally been employed successfully by another, and not because any one had, as yet, been so fortunate as to lay down any broad and definite rules of action. It was for this reason that it was so long in acquiring the confidence of surgeons; that it was totally abandoned at one time, and resumed, with doubts and misgivings, at another. Its principles were not yet fully developed, or placed upon a just and comprehensive basis. This labor was performed by Dr. Bellingham and his able associates, who thus created a new era in the treatment of aneurism, hardly less brilliant than that of the ligature. What the ultimate fate of this treatment will be time alone can determine; that it is destined to supersede entirely, as some have predicted, the use of the ligature, is extremely questionable, and yet, considering the remarkable success which has attended it, such an occurrence seems not improbable.

Compression, as now conducted, is not only safe, but comparatively free from pain; and, although it is often tedious, yet few cases will ultimately resist its influence. It is more particularly applicable to the cure of popliteal aneurism, in which its greatest triumphs have hitherto been achieved, but it has also been successfully employed in aneurism of the lower part of the femoral artery, and in aneurism of the brachial, particularly at the bend of the arm. It is applied at the site of the Hunterian operation, that is, upon a sound portion of the vessel, at the cardiac side of the tumor, and generally at a considerable distance from it; gently and intermittently, not firmly and persistently, as in the old method; just sufficiently to retard and weaken the circulation in the sac, not to arrest it, and so as to favor the gradual formation of clots; allowing time for the development of the collateral vessels, and the maintenance of the nourishment of the distal portion of the member. Occlusion of the artery at the site of compression is not wished for; on the contrary, it is desirable that the vessel should remain pervious, and retain as many of its normal properties as possible. As the stratification of the sac proceeds; as layer after layer of fibrin is deposited, and becomes firmly cemented to that which preceded it, the hollow pouch is gradually filled up, and usually, along with it, also the upper orifice of the artery. To this rule, however, there are occasional exceptions, the blood continuing to flow from the artery in a direct stream across the sac in a sort of ditch, groove, or narrow channel.

For the purpose of making the compression, various instruments have been devised, one of the most simple and efficient of which is represented in fig. 251; it is a modification of that of Charrière, and was successfully employed by Dr. Gibbons, of this city, in a case of aneurism of the popliteal artery. It consists of a long, wide, concave, steel plate, supporting three semicircles of the same metal, arranged in two segments, which slide upon each other, and are connected each at their free extremity with a screw and pad. The whole construction of the instrument is such as to enable the surgeon to regulate the pressure with the greatest nicety; making it more or less firmly, and at one or more points, or alternately at different points, as circumstances may seem to require.

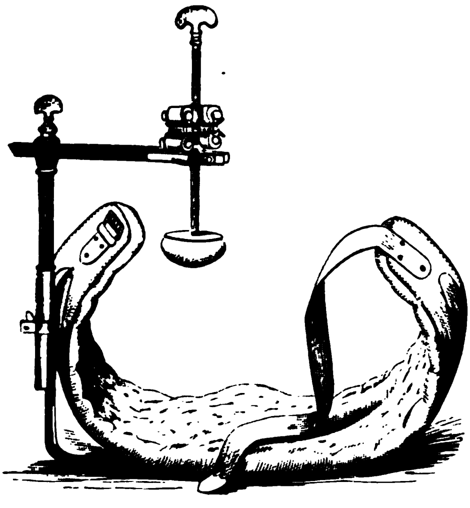
Fig. 251.



Gibbons's modification of Charrière's compressor.

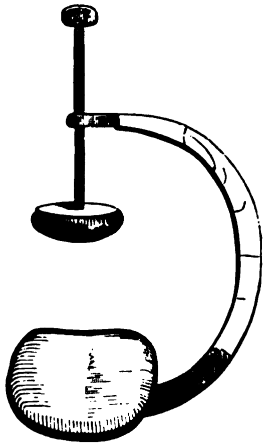
The annexed drawings, figs. 252, 253, and 254, are added for the purpose of enabling the reader to avail himself of the use of other compressors, if the one here described should prove inadequate.

Fig. 252.



Carte's compressor for the cure of femoral and popliteal aneurism.

Fig. 253.

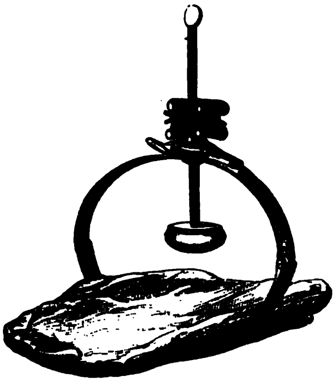


Hoey's clamp.

It will generally be well, if the patient is at all intelligent and trustworthy, to instruct him in the use of the instrument, so that he may regulate the compression, according to its effects; lessening it if it be productive of pain, and conversely.

One important principle in the treatment is to compress the artery against the bone, as a point of support; if the pressure be widely diffused it will only serve to embarrass the venous circulation, and to retard the cure. The preliminary treatment should be the same as in the Hunterian operation; and during the progress of the cure the limb should be kept constantly bandaged from its distal extremity upwards, to support the capillary vessels, and prevent œdema. Strict quietude, both of mind and body, should be observed; the diet should be mild but sufficiently nutritious; and free use should be made of aconite, opium, and acetate of lead, as suggested under the head of the treatment of internal aneurism. If the case is very protracted, and the health is likely to suffer from the consequent confinement, gentle exercise may be permitted in the open air, the instrument being worn several hours in the morning and evening. If any considerable swelling arise in the limb, all treatment must be temporarily suspended, and measures adopted for the relief of the morbid action. To continue the compression under such circumstances would be to jeopard the safety both of the part and patient.

Fig. 254.



Carte's circular compressor.

The period at which a cure may reasonably be looked for in this treatment, is subject to much diversity; in some instances compression for a few hours has sufficed to produce this event; in others, and these embrace the greater majority of cases, a number of days are required; occasionally, several weeks elapse; and cases have been reported where the stratification and obliteration of the sac were not completed under two months. As a general rule, it may be assumed that, other things being equal, the cure will be more rapid in proportion to the smallness of the tumor, the tolerance of the part to compression, and the absence of complications.

The results of the treatment of aneurism by instrumental compression are, on the whole, highly flattering, contrasting most favorably with those of the Hunterian deligation. Thus, of 127 cases of compression, rigidly analyzed by Broca, 116 were successful, or in the proportion of 91 to the 100. Altogether, not more than five or six cases have died from the effects of the operation. On the other hand, the statistics of Dr. Norris, of 188 cases of aneurism of the femoral artery, treated according to the Hunterian principle, show a mortality of 46, or in the ratio nearly of one death to three recoveries. The tables of Mr. Inman, given in a previous page, exhibit a similar result.

Besides its indisputable safety, compression has the advantage, if it fail, that it does not preclude the propriety afterwards of a resort to the ligature.

d. DIGITAL COMPRESSION.

Digital compression for the cure of external aneurism has, during the past few years, attracted some attention, both in this country and abroad, but not in so great a degree as its importance demands. Originally proposed as a distinct measure, in 1846, by Professor Vanzetti, of the University of Padua, it was first successfully employed, a year later, by Professor Knight, of New Haven, in a case of popliteal aneurism, in which he cured his patient in forty hours, the compression having been maintained by assistants.

In a communication in the North American Medico-Chirurgical Review for January, 1859, Dr. S. W. Gross has reported the details of a case of femoral aneurism cured by digital compression, and he has accompanied his paper by a statistical report of twenty-two other examples treated by the same method. As this paper gives a more full account of the subject than any other which has fallen under my notice, I shall freely avail myself of its contents.

It is to aneurisms of the extremities that this procedure is mainly, if not exclusively, applicable, as the compression must be made to bear upon some point of the principal artery of the limb. So far as we have been able to ascertain, the brachial has been compressed in three instances only; once for aneurism of the radial artery near the wrist, and twice for arterio-venous aneurism at the bend of the elbow. In all these cases, the pressure was easily maintained, and the cure was effected in a short time. The femoral artery, at different portions of its course, has been the seat of compression nineteen times for popliteal and femoral aneurisms, of which thirteen cases have been cured. The external iliac has been subjected to the same procedure in two cases of inguinal aneurism; in one the pressure was insupportable, and in the other the assistants became so fatigued that it was discontinued. Moreover, it is very difficult in this situation to keep up the pressure, and such cases should, therefore, be excluded.

It has been shown that digital compression has been successful when mechanical compression was unbearable, or had failed, whether alone or conjoined with other means, interrupted or continued, complete or incomplete; it has even, in several cases, been applied by the patients themselves, and in these instances either a cure was effected, or the tumor was so modified that subsequent ligation, or mechanical compression of the artery always resulted in recovery. In no case has it ever been followed by any bad consequences, as is so apt to happen in ligation.

The pain produced by the pressure of the finger is not greater than that caused by the pad of an instrument; should the point of pressure become tender, flour may be sprinkled upon the surface, or a thin, wet cloth may be interposed between the finger and skin. However this may be, suffering, both local and general, may easily be allayed by the free exhibition of anodynes, which should never be neglected.

Of the twenty-three cases tabulated in the paper of Dr. Gross, fifteen were popliteal, with ten cures, and five failures; four were femoral, with three cures and one failure; two were inguinal, both being unsuccessful; and two were arterio-venous, both of which eventuated favorably. Thus, of the twenty-three cases, fifteen were perfectly successful. Of these fifteen cases, the compression in five was employed independently of other means; in five the digital alternated with mechanical compression; in four cases, apparatus had been abandoned, when digital compression effected a cure; and in one the compression was of a mixed character. Of the failures, in six cases digital compression was employed before other means, and in two after trial by apparatus had been abandoned.

An examination of the facts here detailed will serve to show that digital compression, alternating with the use of apparatus, succeeded in every instance in which it was resorted to, and that, when employed primarily and alone, there were five cures out of seven cases. It seems to me, therefore, that the double method, in which digital and instrumental compression alternate with each other, is the most eligible, not only on account of its having effected cures in every case in which it has been used, but because it is more easy of application, and gives rise to much less inconvenience to the assistants; in fact, the patient himself may sometimes regulate the pressure with perfect success.

The period required for the cure of aneurism by this method is incomparably shorter than by any other known plan of treatment. Thus, of fourteen cases, the shortest time required for a cure was three and a half hours, the longest being seven days, and the average two days and two-thirds. When compared with the cases cured by instrumental compression, the length of time is most striking. In the London hospitals, according to Mr. Hutchinson, the average time for the cure of twenty-six cases of femoral and popliteal aneurism was nineteen days; while Broca found that the mean duration of treatment in ninety-nine cases was about fifteen days. The greatest objection to digital compression is the difficulty of procuring a sufficient number of competent assistants; but in hospital practice, and in large cities, it will always be possible to do so. Since the publication of Dr. Gross's paper, not less than from fifteen to twenty additional cases of cure by digital compression have been reported.

e. FORCIBLE FLEXION.

This mode of treatment, for the introduction of which the profession is indebted to Mr. E. Hart, of England, is applicable chiefly, if not exclusively, in aneurism of the ham and bend of the arm; possibly cases might arise in which it might be employed with advantage in aneurism of the groin and axilla. The principle of the treatment consists in moderating and retarding the flow of blood in the tumor by bending the leg forcibly upon the thigh, so as to approximate the heel to the buttock, and confining it there by means of a strap, the limb being previously enveloped in a bandage. Care is taken to move the knee occasionally, lest anchylosis should occur. The cure is always tedious, from three to six weeks being generally required for the complete arrest of the pulsation, and in a number of the cases in which this treatment has been pursued it has signally failed; in several, the patient was unwilling to bear the restraint which it imposed, and in one at least it caused the rupture of the sac into the joint, necessitating the ligation of the femoral artery.

It is obvious that this mode of treatment, which commends itself by its great simplicity and freedom from pain, is more likely to succeed in small and recent aneurisms than in large and old, in which it must of necessity be occasionally attended with failure. Indeed, it can hardly be considered as applicable to the latter class of cases, as it might induce rupture of the sac, as in the instance related by Mr. Moore, or be even productive of gangrene of the leg.

f. GALVANO-PUNCTURE.

It would seem that this operation for the radical cure of aneurism was first suggested, in 1832, by Mr. Benjamin Phillips, of London; so far, however, as my information extends, it was not practised by him upon the human subject, and the idea had almost been lost, when, several years ago, it was revived, principally through the agency of Mons. Pétrequin, of Lyons. The operation is founded upon a knowledge of the fact that the galvanic current has the effect, if properly directed, of coagulating the blood as it circulates through the different parts of the body. It is executed by means of two long, slender steel needles, introduced into the aneurismal sac at right angles, and in such a manner as to touch each other, their heads being then connected to the chain of a galvanic battery of moderate tension. The action of the battery is maintained uninterruptedly for a period varying from ten to twenty-five minutes, according to the tolerance of the part, and is usually required to be several times repeated. When the tumor is large the number of needles is increased, and the direction of the current frequently changed, so as to afford a better chance for the formation of clots. As the operation is generally very painful, it is proper that the patient should be placed under the influence of chloroform during its performance. Moreover, as there is danger of seriously charring the integuments, and thus endangering the sac by mortification, the needles should be carefully coated, in a part of their extent, with gum-lac. The success of the procedure is enhanced by compression of the artery above and below the tumor, thereby preventing the clots from being washed away, before an opportunity has been afforded them of becoming consolidated and united with each other and the walls of the aneurism. The after-treatment consists in the application of ice to the part, in perfect quietude, and in the administration of a full anodyne, to tranquillize the action of the heart and arteries.

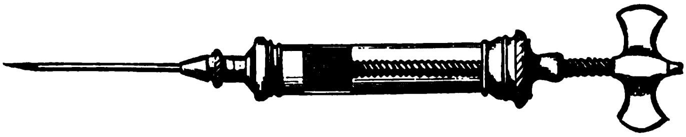
Experience has not yet fully determined the value of this mode of treatment. That it is liable to occasional failure is sufficiently evident from the unsuccessful cases that have from time to time been published in England and on the continent of Europe. On the other hand, a considerable number of cases have been reported where its employment was followed by a perfect cure. Of twenty-two cases, collected by Mons. Boinet, in 1851, in which the operation had been practised, nine are stated as having been successful, and thirteen as having been failures. Cases of cure, by this method, of aneurism of the brachial, subclavian, popliteal, and external iliac arteries have been reported by different observers since that period, and, doubtless, others have occurred of which I have no knowledge.

Galvano-puncture is not only painful, but far from being devoid of danger. In some of the reported cases it produced severe inflammation and even suppuration of the sac, followed by great swelling of the limb, together with excessive constitutional disturbance threatening the destruction both of the part and system. The operation is, therefore, a hazardous one, and on this account should never be attempted without due consideration of its consequences, especially when the aneurism is large and situated at, or near to, the trunk. Coupling this circumstance with the want of success of the operation, and the severe pain attending its execution, not to say anything of the danger of producing sloughing in the skin and sac by the action of the galvanic fluid as it is being transmitted from the battery to the tumor, it is questionable whether it is worthy of repetition, notwithstanding the high estimate placed upon it by Pétrequin, Burci, and some other surgeons. The force of this conclusion derives additional support from the facts collected by Mons. Boinet, that in seven of the successful cases, above referred to, compression and ice were employed simultaneously, thus creating a just doubt in the mind of the inquirer whether these agents had not as much to do with the cure as galvano-puncture, if, indeed, not more. I am not aware that this operation has ever been performed in this country, and I trust that it may never be undertaken by any one who is not perfectly familiar with the pathology of the disease.

g. INJECTION.

Attempts have been made in modern times to effect the radical cure of aneurism by the injection of certain fluids with a view of favoring the concretion of the blood, the consolidation of the sac, and the obliteration of the affected artery at the seat of the disease. The practice was originally suggested, early in the present century, by Professor Monteggia, of Milan, who proposed the use of solutions of acetate of lead, tannin, and other astringents, as, in his opinion, well adapted to the purpose, although he never, it would seem, performed the operation. His idea was that, by throwing these substances into the sac, so as to bring them fully into contact with the blood within, it might be possible to provoke the rapid formation of coagula, and thus effectually arrest the circulation. He supposed, moreover, that the remedy might occasionally be advantageously combined with Brasdor's operation and with compression of the artery upon the cardiac side of the tumor, applied by means of a tourniquet or some other suitable instrument, very much as it is performed at the present day. The suggestion of the Italian surgeon, however, received little, if any, attention, until within a comparatively recent period, when it became the subject of numerous experiments upon the inferior animals, as the sheep, dog, and horse, principally by the French practitioners, who, after having tried various articles, have at length been induced to give a decided preference to a concentrated solution of perchloride of iron in water. The fluid is introduced into the sac by means of a small glass syringe, invented by Mons. Pravaz, of Lyons, and represented in fig. 255, a puncture having previously been made with a delicate trocar and canula, the latter of which is retained in the sac until the injection is completed. The piston of the syringe is moved by means of a screw, so as to enable us to perform the operation more steadily, and without the risk of throwing in more than five or six drops of fluid, that quantity having been found to be quite sufficient for the purpose. As it takes at least half a minute before the blood can be made to coagulate, during which the heart performs not less than thirty-five pulsations, it is necessary to keep the contents of the tumor perfectly quiet, while the injection is progressing, by compression of the artery immediately above and below the aneurism.

Fig. 255.



Pravaz's syringe.

The operation is generally productive of severe pain, and as it is liable to be followed by considerable inflammation, it often becomes necessary to make use of antiphlogistic measures, both locally and constitutionally. Its repetition must be governed by circumstances; if everything passes off well, and the sac is promptly solidified, no further interference will, of course, be demanded; but if the reverse be the case, a similar quantity of the solution is thrown in at the end of the third or fourth day, and in the same cautious manner as before. The slightest inflammation of the tumor contraindicates the repetion of the injection.

Since 1853, when Mons. Pravaz first published the results of his experiments on animals, a number of cases have been reported in which injections of the perchloride of iron have been employed in aneurism of different parts of the body, as well as in aneurism of different kinds, as spontaneous, traumatic, and varicose. The arteries upon which the disease occurred were the supra-orbital, carotid, humeral, ulnar, femoral, popliteal, and tibial.

Although a few cures have been effected by this treatment, yet such is the great risk of inflammation, suppuration, and even gangrene, both of the sac and of the surrounding structures, that it is extremely questionable whether any prudent surgeon should repeat it. Of eleven cases, reported by Malgaigne in 1854, it is announced that four had proved fatal, that every one had had bad symptoms, and that only two had been successful. This statement alone, if true, as no doubt it is, is sufficient to condemn the operation as unsafe, and to render its adoption improper in the face of the more unexceptionable methods of ligation and compression. The great desideratum is to discover an article, which, while it shall promptly coagulate the blood, will not cause any severe irritation in the sac and the parts around it. It has been supposed that the acetate of the peroxide of iron might have this effect, but, although at least one successful cure by its use has been reported, yet it has not been tried sufficiently often to enable us to pass any definite judgment respecting its true merits. I should myself have more confidence in the efficacy and safety of the persulphate of iron, generally known as Monsel's salt, than in any other preparation of this metal. It is perfectly destitute, or nearly so, of caustic properties, and is the most prompt and efficient coagulator of the blood of which we have at present any knowledge.

h. MANIPULATION.

Very recently the attention of the profession has been called to a new treatment of aneurism by Mr. Fergusson, of King's College, London. It is termed the method by manipulation. It consists in the forcible squeezing of the tumor, with the intention of breaking up its fibrinous contents in order that some of the fragments thus detached may be carried by the circulation into the distal extremity of the artery, thereby closing its orifice, and so effecting a radical cure. The operation was first performed in 1852, in a case of aneurism of the right subclavian artery, seated partly within and partly on the outside of the scalene muscles, the tumor being about the size of a hen's egg. The sac being emptied of fluid blood, its sides were forcibly rubbed against each other, with the immediate effect of an arrest of pulsation in all the vessels in the limb below. The pulsation, however, returned in about seven hours, and the manipulation was accordingly repeated the next day with a similar result, but it was not until the end of a week that any permanent impression appears to have been made upon the circulation. The tumor now gradually diminished in size, and everything gave evidence of an ultimate cure, when suddenly, seven months afterwards, the patient was seized with violent fever attended with excruciating pain in the part, and died after a few days' illness. Although the axillary artery was found, on dissection, to have been blocked up, the tumor, instead of being obliterated, not only remained hollow, but had extended downwards over the axillary plexus of nerves, the pressure upon which had probably caused the excessive pain which immediately preceded dissolution. In another instance, operated on by the same gentleman, the result was more fortunate, but the cure was not finally effected until towards the end of the second year. Within the last few years several other cases, also successful, have been reported by other surgeons, among whom I may mention Professor Blackman, of the Medical College of Ohio.

In a case of popliteal aneurism recently reported by Mr. Teale, of Leeds, this plan of treatment was successfully conjoined with digital compression. After the latter had been carried on for some time with, apparently, very little effect, a portion of clot was detached, leading at once to the consolidation of the tumor.

I have not had an opportunity of trying Mr. Fergusson's plan of treatment, but it is, I think, extremely questionable whether it ought to be repeated. The great objections to it are, first, the uncertainty of the operation, even when the distal end of the artery has been blocked up; secondly, the tardiness of its progress; and thirdly, the danger that some of the detached clots may find their way into the brain, as in aneurism of the neck, thus causing fatal apoplexy, as has already happened in several cases in which the method has been tried. If employed at all, therefore, it should, in my judgment, be restricted to aneurism of the subclavian, axillary, femoral, and popliteal arteries, in the early stage of the disease, before the tumor has acquired any considerable bulk.

i. VALSALVA'S TREATMENT OF INTERNAL ANEURISM.

Internal aneurisms, inaccessible to the ligature and compression, occasionally recover under a regular and systematic course of treatment designed to promote the coagulation of the blood in the interior of the tumor, by increasing the plastic properties of this fluid, and quieting the action of the heart and arteries. This treatment, which was originally suggested by Valsalva, and which still bears his name, consists in the strict observance of the recumbent posture, perfect mental quietude, the occasional abstraction of blood from the arm, and the use, simply, of a sufficiency of food and drink to prevent starvation. When, writes Morgagni, Valsalva had taken away as much blood as was deemed necessary, he diminished the diet "more and more every day, until only half a pound of pudding was taken in the morning, and in the evening half that quantity, and nothing else except water, the weight of which was also regulated, and which he medicated with what is called quince-jelly, or the lapis osteocolla, ground down into a very fine powder. After the patient had been sufficiently reduced by this method, so that he could scarcely raise his head from the bed, to which, by Valsalva's direction, he was confined, the quantity of aliment was day by day increased, until the strength that was necessary to enable him to get up had returned." Most modern writers, in speaking of this method, recommend, as important adjuvants, the internal exhibition of digitalis, acetate of lead, and opium, with a view of insuring more speedily and effectually the ends proposed by Valsalva and his followers; the digitalis being given to diminish the number and force of the pulsations of the heart and arteries, the lead to increase the coagulability of the blood, and the opium to allay pain and nervous irritability.

We have no account of the number of cases of aneurism successfully treated by Valsalva by this method, but that he cured several persons with it is a conjecture warranted by the statements of Morgagni, by whom it was first described. What is still more to be regretted is the fact that we are equally ignorant in regard to the results obtained by others. But, notwithstanding this, it seems to me that the treatment is worthy of more attention than it has hitherto received, especially of late years, when so little has been said and done concerning it. The question, however, arises whether it might not be beneficially modified, so as to render it better adapted to the attainment of the object which it is designed to accomplish. In reflecting upon the subject, some years ago, it occurred to me that, instead of bleeding and starving the patient, upon which so much stress was laid by the Italian practitioner, the end might be more easily and speedily obtained by the abandonment of the lancet altogether, and the substitution of nutritious food, in as dry, concentrated, and non-stimulant a state as possible. If the object be to procure a more plastic and coagulable condition of the blood, to promote the formation of clots, this can certainly be done much more advantageously, as well as in a much shorter time, by such a course than by one of an opposite character. Repeated bleeding and a light farinaceous diet, comprising a little pudding and jelly, taken twice a day, must, unquestionably, render the blood very thin and watery, and therefore less disposed to fibrinization, the very reverse of what is really needed for the cure of aneurism. It would be more in accordance, then, with sound physiology and practice, to refrain from venesection entirely, and to put the patient upon a moderate allowance of food, as a few ounces of equal parts of hashed meat and bread, potato, or rice, at dinner, with a suitable quantity of stale bread, toast, or cracker at breakfast and supper; tea, coffee, and all other drinks, excepting water and lemonade, as well as all kinds of condiments, being scrupulously avoided. The patient should be kept perfectly at rest, in the recumbent posture, with the mind in as tranquil a state as possible, while the system should be steadily maintained under the free use of the tincture of aconite, or of veratrum viride conjoined with acetate of lead and opium, or, what would probably be better, the persulphate of iron. The pulse should be brought down, if practicable, to forty or forty-five beats in the minute, and the chances of success would be all the greater if a prolonged state of somnolency could be maintained, the patient sleeping the greater part of the twenty-four hours. Protracted constipation of the bowels should be aimed at; if purgatives become indispensable, they must be of the mildest character, as all irritating and griping articles are sure to do harm by exciting the action of the heart and arteries.

The length of time during which this treatment should be continued must vary according to the circumstances of each individual case, and no attempt should, therefore, be made to reduce it to any general principles. It certainly might, with judicious management, be kept up, without detriment, for several consecutive weeks. As the patient emerges from it, he should return, but most gradually and cautiously, to his accustomed diet, except that, for a long time afterwards, it should be free from all stimulants; nor should he, for many months, take any, except the most gentle, exercise. In short, everything should be done calculated to second nature in her efforts to effect the cure thus auspiciously begun, and which, other things being equal, will always be so much the more likely to take place if the aneurism be small and of recent standing.

Since the publication of the first edition of this work, I have had an opportunity of treating three cases of intra-thoracic aneurism according to the plan here sketched; but, although the patients seemed to be materially benefited, as far as their pain was concerned, and the pulse was brought down below fifty, I was not able to satisfy myself whether the progress of the disease was at all retarded. It is proper, however, to add that all the cases were far advanced when they fell into my hands.

j. GENERAL MEDICAL TREATMENT.

Persons affected with aneurism often experience, as stated elsewhere, great pain and other suffering, both from the inflamed condition of the tumor and from the pressure which it exerts upon the surrounding parts. In aneurism of the thoracic portion of the aorta and of the arteries at the root of the neck, the pain and dyspnœa are sometimes excessive, demanding prompt and vigorous measures for their relief. If the patient be plethoric, and the pulsation in the tumor uncommonly active, the loss of twelve, fifteen, or twenty ounces of blood will be useful, but care must be taken not to carry the venesection too far, otherwise injurious reaction may take place, and thus aggravate the suffering. When the tumor is accessible, or situated externally, whether partly or entirely, the blood is often most advantageously abstracted directly from the part by means of leeches, which, even when employed only in small numbers, generally afford immense relief, both as it respects the pain and the difficulty of breathing. Topical depletion is always extremely serviceable in inflamed aneurism, and it is here also that fomentations and refrigerating lotions, simple or medicated, come into play, frequently exerting their happiest influence. Our choice of these remedies must be governed in these, as in other cases, by the tolerance of the part and system. Attention to position and rest must be enjoined, and strictly carried out. The bowels are not neglected, but great care is taken to avoid active purgation, experience having shown that such a procedure always produces undue excitement of the vascular and nervous systems. Anodynes are always well borne in these cases, and should be administered in full doses, either alone or in union with diaphoretics and expectorants, according to the state of the skin and of the respiratory organs. Any complications that may arise during the progress of the disease, whether self-existent or dependent upon the irritation produced by the pressure of the tumor, must be treated upon broad general principles.

FALSE ANEURISM.

A false aneurism consists, as already stated, of a pulsating tumor formed external to the affected artery, and, consequently, without any aid from its tunics, which are altogether excluded from its composition. A number of affections, of a very opposite character, have been described under this appellation, and the result has been, as might have been anticipated, much confusion. To remedy this evil, I shall limit myself, in the account which I am about to give of the disease, to two varieties of false aneurism, the arterial and arterio-venous, the tumor in each being strictly circumscribed, and connected, in the former, with an artery, and, in the latter, both with an artery and a vein. What is called a diffused aneurism is, in fact, as stated elsewhere, no aneurism at all, but merely an accumulation of blood in the subcutaneous and intermuscular cellular tissue, which, although it may be somewhat condensed around it, yet does not, in reality, in the true meaning of the word, constitute a proper aneurismal sac.

The most common cause of the spurious arterial aneurism is external injury, as a stab or puncture, such, for example, as is so often inflicted in venesection at the bend of the arm, permitting the blood to escape in small quantity into the surrounding cellular substance, which is soon condensed into a firm, circumscribed, pulsating cyst, often not exceeding the volume of a pullet's egg, and of a rounded or ovoidal figure. Similar effects occasionally follow the laceration of an artery, as that of the ham, from the sudden and forcible extension of the leg, from the intrusion of the sharp end of a broken bone, or from ulcerative action.

Sometimes the aneurismal formation is secondary; that is, consequent upon the partial cicatrization of the wound, the interposed or overlying plasma being unable to withstand the impulse of the blood, and so yielding before it. However induced, all the tunics of the artery are at once perforated, and the blood is sent abroad into the circumjacent cellular tissue, in the manner and with the effect just stated.

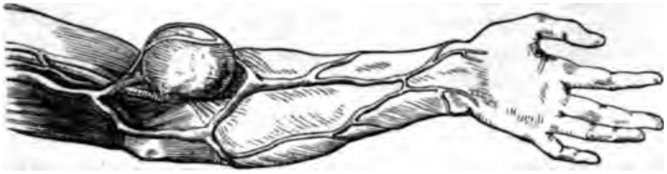
The sac in this variety of aneurism, formed originally, as has just been remarked, out of the neighboring cellular tissue, is speedily strengthened by the effusion of plastic matter, so that, in time, it often acquires considerable thickness with an extraordinary degree of density. I have seen a number of cases where the cyst, even at an early stage of the disease, was of a very firm, compact, fibroid consistence, and of a white, glistening appearance, its substance being convertible, by dissection, into several distinct strata. The tumor, particularly in cases of long standing, generally contains well organized concretions, arranged in the same concentric manner as in the true sacculated aneurism, and presenting a similar hue and consistence. The course, symptoms, and termination of this disease do not require any special notice, as they do not differ, in any respect, from the ordinary form of the affection.

The *treatment* may be conducted by compression, or, this failing, by ligature. The compression is applied, as in true aneurism, upon the cardiac aspect of the tumor, four, six, or eight inches from it, with the instrument already described, retardation of the circulation and gradual obliteration of the sac being steadily kept in view. If an operation becomes necessary, a free incision is carried across the tumor, and a ligature applied immediately above and below, as in an ordinary wounded artery. The tumor may then be dissected out, or, as some prefer, though I think improperly, it may be left to the influence of the absorbents. As a preliminary step, a tourniquet is cast around the limb to control the circulation in the affected vessel. Although one ligature is occasionally sufficient to effect a cure in this disease, yet I would strongly advise the ligation of the vessel both above and below the swelling, lest trouble should arise on account of the recurrent circulation, and thus lead to the necessity of doing at a subsequent period what ought to have been done in the first instance. The memorable case of Anel affords an excellent illustration of the fact that an aneurism of this kind, especially when seated at the bend of the arm, may occasionally be cured by a ligature applied just above the tumor.

1. The *arterio-venous* aneurism, originally described under the name of varicose aneurism, consists of a tumor which is situated, as the term implies, between a contiguous artery and vein, so as to admit of a ready interchange of the two kinds of blood. The most common site of the lesion is the bend of the arm, as seen in figs. 256 and 257, where it is generally caused by a puncture in bleeding, in which the overlying vein, usually the median basilic, is completely transfixed along with the superficial wall of the brachial artery. A similar accident may, of course, happen in any other part of the body, from a stab or wound of a contiguous artery and vein, as between the femoral, or between the aorta and vena cava. Sometimes, again, the aneurism forms in consequence of ulceration, beginning in one vessel and gradually extending to the other, and so eventually establishing a communication between them through the intervention of a sac.

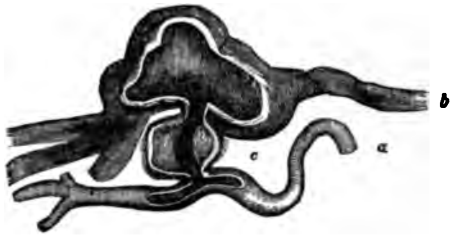
In whatever manner the aneurism is formed, the cyst is usually of small size, seldom exceeding, and not often equalling, that of a pullet's egg. It is composed partly of condensed cellular substance and partly of plastic matter, the latter always greatly predominating, as is shown by its extraordinary thickness as well as density, which closely resembles that of the fibrous tissue. The tumor, although it is seldom the seat of much pain, interferes more or less with the functions of the affected limb. The opening of communication being always very small, the blood rushes into it with a peculiar noise, not unlike that produced by the buzzing of a fly in a paper box, or the purring of a cat. Sometimes it is of a whirring character, similar to the prolonged articulation of the letter R. It is perceived both by the ear and finger, and is so extraordinary that it may be regarded as pathognomonic of the nature of the affection. The sac rarely contains any well-formed fibrinous concretions, and, on laying it open, it is often found to be perfectly smooth and white, like the interior of an artery. Manifesting little disposition to increase, it sometimes remains stationary for years, but seldom, if ever, undergoes spontaneous cure, or terminates in rupture, ulceration, or gangrene.

Fig. 256.



Varicose aneurism; external appearance.

Fig. 257.



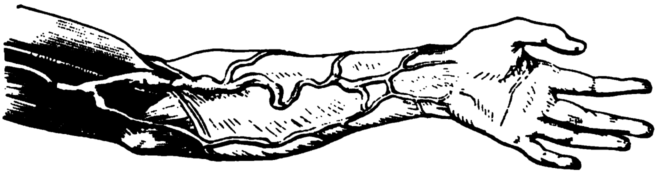
Varicose aneurism; internal view. *a*. The artery. *b*. The vein. *c*. The intermediate cyst.

When the tumor is very small, not exceeding the volume of a filbert or a pigeon's egg, and does not occasion any suffering, interference is neither desirable nor proper; it is merely an inconvenience, and had better be let alone. The reverse, however, is usually the case, and then the same treatment will be required as in spurious aneurism connected with an artery only; that is, the vessel is tied just above and below the tumor, which is left to undergo absorption, lest its removal should give rise to phlebitis in consequence of the unavoidable injury inflicted upon the affected vein.

When the disease occurs in connection with the aorta and vena cava, operative interference will, of course, be out of the question; nor can anything be hoped for from medical treatment. The case, in fact, is irremediable, and will be sure, in time, to cause death, either by the gradual giving way of the sac, or by exciting violent irritation, pain, and constitutional disorder.

2. *Aneurismal varix*, fig. 258, consists in a direct communication between a contiguous vein and artery, without the intervention of a sac; it differs, therefore, essentially from a varicose aneurism, in which, as has just been seen, there is always a distinct cyst, formed out of the surrounding tissue, along with more or less plasma. The affection is altogether so unlike aneurism, whether true or spurious, that it is surprising it should ever have been included under the same category.

Fig. 258.



Aneurismal varix.

The cause of aneurismal varix—a disease first described by Dr. William Hunter, in 1756—is usually some external injury, such as a puncture, transfixing a vein and piercing the contiguous wall of an underlying artery. Hence, the lesion is most common at the bend of the arm, between the median basilic vein and brachial artery, in consequence of venesection. It may, however, occur between other veins and arteries lying in juxtaposition with one another, either through accident, or from the effects of ulceration commencing in the coats of one vessel and gradually perforating those of the other. The orifice of communication is usually small, and of a circular shape, with well-defined margins, although there is, in this respect, no particular uniformity. The adhesion between the two vessels is generally very firm, as well as of considerable extent, and it is well that it should be so, otherwise there would be constant danger of the connection giving way. Owing to the incessant interchange and commingling of the two kinds of blood, the vessels gradually undergo important changes, the most interesting of which are that the vein assumes the properties of an artery, and the artery those of a vein. The vein, from the impetuous manner in which the arterial blood is sent into it at each stroke of the heart, becomes greatly enlarged both above and below the abnormal opening, at the same time that it acquires an extraordinary degree of density, and pulsates with unusual force. In the arm, where I have met with several instances of this disease, I have found the dilatation of the vein extend, on the one hand, nearly as high up as the axilla, and on the other, as low down as the middle of the forearm. The artery, which now receives black blood, but not in any large quantity, is eventually transformed into a soft, thin, flexuous tube, which, possessing rather the properties of a vein than those of an artery, pulsates but feebly under the finger.

The formation of this disease is generally attended with some degree of pain and swelling, along with interstitial effusions, causing the integuments to pit slightly on pressure. The parts below the seat of the lesion are imperfectly nourished, and hence they usually feel somewhat cold and numb until the circulation is fully re-established through the agency of the collateral branches. As the blood passes from one vessel into the other it produces a peculiar jarring sensation and a singular whirring noise, not unlike the purring of a cat, which often extends to a great distance along the dilated vein, now performing the vicarious functions of an artery, and which may be regarded as the pathognomonic signs of the disease.

In the cases of this lesion which have fallen under my observation, the inconvenience has been so trifling that I have not considered it proper to resort to operative interference. In one instance the patient had an aneurismal varix on the right arm from venesection performed upwards of fifteen years previously, and, although he was a blacksmith and a hard working man, it did not in the slightest degree interrupt his occupation. When trouble arises so as to render treatment necessary, relief may be attempted by compression of the brachial artery, as in varicose aneurism; this failing, the artery should be exposed by a careful dissection, and a ligature applied both above and below the orifice of communication, all disturbance of the vein being avoided.

SECT. VII.—ANEURISM OF PARTICULAR ARTERIES.

ANEURISM OF THE THORACIC AORTA.

The merest glance at the situation of this vessel is sufficient to impress us with the great importance of its relations, and to show that any deviation from its normal condition, however slight, may be productive of the most frightful consequences.

The disease may exist, 1st, as a fusiform expansion; 2dly, as a dilatation of the coats of the vessel, affecting the greater portion, if not the whole, of its circumference; or, 3dly, as a true, false, or mixed aneurism, properly so called, of variable size and shape, generally connected with the anterior or lateral aspect of the artery, the posterior part being seldom implicated. The ascending portion and arch of the aorta, especially the latter, are by far the most frequent seats of the disease, owing to their vicinity to the heart, which thus imparts to them its impulsive and expansive movements, and to their greater proneness to fatty and other degenerations, rendering their tunics weak and brittle, and consequently liable to laceration. In most cases, the aneurism is of the true species, commencing as a sac-like enlargement, which, as it increases, usually inclines to the right side of the chest, and is capable of acquiring a volume equal to that of a double fist. It soon becomes occupied with organized clots, which occasionally, though very rarely, accumulate to such an extent as to lay the foundation of a spontaneous cure. The opening of communication between the tumor and the artery varies in size from that of a dime to that of a twenty-five cent piece.

The disease, which is more common in men than in women, not unfrequently arises at a comparatively early age, as from twenty-five to thirty, in consequence, apparently, of severe straining and other bodily exertions. Sailors and mechanics are peculiarly liable to it. The astonishing frequency of aneurism of this vessel is shown by the tables of Mr. Crisp, embracing 915 cases, of which 382 affected the thoracic aorta.

The duration of thoracic aneurism varies from a few months to upwards of three years, the average being from nine to twelve months. The tumor usually bursts into the left pleura, pericardium, trachea, bronchial tubes, œsophagus, or posterior mediastinum; sometimes into the heart, lungs, or spinal canal, and sometimes, again, but also very rarely, externally. Dr. Darrach, of Illinois, has shown by an analysis of twenty-three cases that aneurism of the descending aorta terminates pretty uniformly by rupture, while that of the arch generally ends by exhaustion and irritation, or some concomitant disease of the heart, brain, lung, or kidney. Occasionally the tumor gives way when it is not larger than a pullet's egg.

The *symptoms* of aneurism in this situation are chiefly of a mechanical character, arising from the pressure of the tumor upon the surrounding structures. They consist mainly of pain, cough, dyspnœa, dysphagia, enlargement at the sterno-clavicular region, and of various kinds of sounds, synchronous with the action of the heart.

Pain, from the constancy of its occurrence, is a symptom of great value. It comes on early in the disease, is more severe in sacculated than in fusiform aneurism, and is evidently dependent, at first, or so long as the tumor is comparatively small, upon the pressure which the aneurism exerts upon the spinal and sympathetic nerves, and afterwards upon this cause and upon the erosion and perforation of the tissues, especially the sternum, ribs, and vertebræ. It varies much in degree, character, and situation. In the earlier stages of the disease it is most conspicuous on the left side; it is sharp, lancinating, and intermittent, not unlike the pain of neuralgia, darting about in different directions; at one time into the neck and face, at another through the chest and spine, now along the shoulder and arm, and now through the diaphragm and even the loins. As the tumor enlarges, and erodes, by its pressure, the neighboring structures, the pain becomes more steady, fixed, and severe; it gradually shifts to the right side, and is generally of a burning, gnawing, or boring character.

Cough is also a common symptom; it generally begins early in the disease, and is liable to severe exacerbations, often productive of intense suffering. It is of a crowing, stridulous, or ringing character, and it obviously depends upon the irritation caused by the pressure of the tumor upon the air-passages. Sometimes it is short, spasmodic, and laryngeal.

Dyspnœa is always more or less distressing, especially when the disease has made considerable progress, and is invariably aggravated by severe bodily exertion, as in walking up a hill, or ascending a flight of stairs. It is occasionally extremely violent, although the tumor may not exceed the size of a walnut, owing to the pressure which it exerts upon the trachea, or the trachea and bronchial tubes. During the latter stages of the complaint, the breathing is always so difficult as to prevent the patient from lying down, perhaps for days before he expires.

Dysphagia is seldom present until after the disease has made considerable progress, although it is sure, in the end, to become a prominent symptom; so that, ultimately, the sufferer finds it very difficult to swallow anything either in the form of food or drink.

It is not often that there is any external tumor, except when the aneurism points in front of the chest, as it frequently does in the latter stages, after it has partially destroyed the sternum and the ribs, or the ribs and intercostal cartilages. In the great majority of cases it shows itself on the right side of the chest from three to four inches below the collar bone, as a pulsating swelling, lifting up the integuments synchronously with the contraction of the heart, furnishing a distinct bellows, sawing, or purring sound, and being exquisitely tender on pressure. Occasionally the sac projects into the neck above the fourchette of the sternum, inclining towards the right sterno-clavicular articulation. When this is the case, it must necessarily overlap the innominate, common carotid, and subclavian arteries on the right side, and may even so effectually compress them as to cause their obliteration, although such an event is very unusual.

A distinct aneurismal sound, or purring tremor, is usually perceptible at an early stage of the disease, although it is extremely difficult, if not impossible, always to refer it to its proper source. It is synchronous with the beat of the heart, and gradually becomes more and more faint as the disease advances, in consequence of the progressive filling up of the sac by coagula.

Among the less constant symptoms are, palpitation of the heart, wheezing, panting, or asthmatic respiration, tracheal and bronchial râles, sense of constriction of the chest, œdema and lividity of the face, feebleness and irregularity of the pulse at the wrist, from the pressure of the tumor upon the innominate or subclavian artery, and anasarca of the extremities, especially the inferior. Alteration of the voice is by no means uncommon, and occasionally amounts to complete aphonia. In the more advanced stages of the disease there is also frequently an enlarged and varicose state of the subcutaneous veins over the upper part of the chest, generally towards the right side.

Now, although intra-thoracic aneurism manifests itself by numerous symptoms, yet there is not one that can be considered as absolutely *diagnostic*. It is not surprising, therefore, that the disease should occasionally terminate fatally, without any suspicion as to its true nature. Such an error will be most likely to happen when the tumor is small, or when it bursts into some neighboring canal before it has sensibly encroached upon the walls of the chest. As it increases in volume, its character becomes daily more and more apparent, and all doubt must, of course, vanish when the tumor points externally, although even then a careless practitioner might regard it as an abscess, and, under this supposition, be perhaps even induced to open it, as I have known to be done in two cases, notwithstanding the heaving and pulsating nature of the swelling, and the existence of all the other signs of aneurism. When the aneurism arises from the summit of the aorta, the tumor projects into the root of the neck, and may indeed ascend so high up as to simulate aneurism of the innominate or carotid artery. From this, however, it may in general be readily distinguished by the history of the case, by the impossibility of tracing with the finger the lower boundary of the tumor, by the dulness on percussion of the upper part of the chest, and by the presence of a larger amount of dyspnœa than usually attends cervical aneurism, particularly in its earlier stages.

The auscultatory signs rarely afford any conclusive evidence of intra-thoracic aneurism. Few surgeons are able to discriminate between the sounds of the heart and those of such a tumor, and the difficulty must necessarily be much increased when, as not unfrequently happens, aneurism and cardiac disease co-exist. When the heart is sound, and the aneurism has attained a considerable bulk, the diagnosis will be less ambiguous; but even then it will require a very practised ear to detect the varying shades of difference. The sound of a thoracic aneurism is more like the purring of a cat than the clear murmur attending the first sound of the heart, and its distinctive features are still further defined by the presence of a peculiar tremor or vibratory movement. In the sacculated variety of the affection, it is often impossible to distinguish any abnormal sound whatever; at first, because of the small size of the swelling and subsequently, because the tumor is filled with coagula, impeding, if not preventing, the transmission of sound. In fusiform aneurism, and also in simple but extensive dilatation, the sound characteristic of the disease is generally easily recognized throughout its entire progress.

Dulness on percussion, in a marked degree, can exist only in the event of the tumor being of considerable bulk; a small aneurism may be present, and even prove fatal, without any change of resonance. When there is dulness, it is always most conspicuous at the upper and middle parts of the chest.

Sometimes valuable diagnostic information may be derived from the displacement of the heart by the tumor, its pulsations being perceived in an abnormal position, where there is no evidence of pleuritic effusion or disease of the lung to account for the change.

Among the affections with which aneurism of the thoracic aorta is most liable to be confounded are malignant tumors of the chest, especially encephaloid, disease of the heart, as hypertrophy and valvular derangement, and aneurism of the innominate, carotid and subclavian arteries. The best security against error will be an attentive consideration of the history of the case, and a thorough study of its progress, time often throwing more light upon the character of the malady than the most elaborate auscultatory explorations.

The *treatment* of intra-thoracic aneurism resolves itself into the adoption of measures calculated to relieve the patient's sufferings rather than to cure his disease, of which there is, in any case, hardly even a remote possibility. If plethora exist, an occasional bleeding cannot fail to ameliorate, at least for a time, the pain and difficulty of breathing. The circulation should be controlled by the cautious exhibition of veratrum viride, the diet be light and concentrated, the bowels maintained in a soluble state, and suffering allayed by anodynes. Perfect quietude of mind and body must of course be observed.

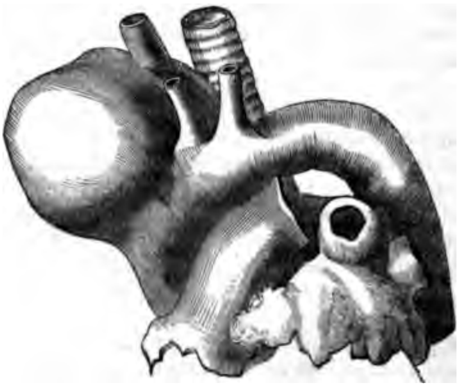
ANEURISM OF THE INNOMINATE ARTERY.

The relative frequency of aneurism of the innominate artery does not admit of any definite statement, owing to the great discrepancy in our statistics. Thus, in 179 cases of spontaneous aneurism, excluding those of the aorta, analyzed by Lisfranc, the innominate is mentioned only four times, while the carotid is mentioned seventeen times and the subclavian sixteen. In Mr. Crisp's table of 551 cases, embracing 234 of aneurism of the aorta, the innominate was affected in 20, the carotid in 25, and the subclavian in 23. The disease, as in the other arteries, is much more common in men than in women, and in the laboring than in the higher classes of persons. The greatest number of cases occur between the thirty-fifth and fifty-fifth year. It may exist by itself or be associated with aneurism of the arch of the aorta, the carotid, or subclavian. The extent of involvement varies from the slightest increase of the normal size to an enormous tumor, either tubular, fusiform, or sacculated in its character. Whether every portion of the vessel is equally liable to be affected is uncertain, but observation has shown that the disease is sometimes situated so low down as to become identified with the arch of the aorta, while at other times it is so high up as to extend into the carotid and subclavian. Occasionally, it is limited to the middle of the vessel, each extremity retaining its healthy appearance.

Symptoms.—Aneurism of the innominate artery usually begins as a small tumor at the right sterno-clavicular articulation, between the trachea and the inner edge of the mastoid muscle, immediately above the inner third of the clavicle. In some cases, the patient is conscious of the moment when the accident takes place, there being a feeling as if something had given way while he was shaken by a violent paroxysm of coughing or engaged in lifting a heavy weight. The tumor, at first, is generally very small, probably not exceeding the size of a little almond, of a rounded or ovoidal shape, distinctly circumscribed, and slightly movable on pressing the finger firmly down into the hollow at the top of the sternum. It is not long, however, before it increases in volume; commonly, in fact, it grows rapidly, soon attaining a large bulk, extending upwards into the neck, and laterally towards each side, but especially towards the right, where there is least resistance. As it progresses, it gradually pushes forwards the mastoid muscle, and even the sterno-clavicular articulation, forming thus a large prominence, beating and throbbing violently beneath the skin. Now and then, upon escaping from the chest, the tumor ascends high up into the neck, perhaps nearly on a level with the larynx, and when this is the case it is not uncommon for it to present a constricted, hourglass-like appearance, as if a cord had been drawn tightly across its middle.

Effects on Neighboring Structures.—The effects which the tumor exerts upon the neighboring parts, fig. 259, are chiefly of a mechanical character, and must be considered with reference, first, to the vessels of the superior extremity, neck, and head; secondly, the trachea and œsophagus; thirdly, the aorta, heart, and vena cava; fourthly, the nerves of the neck and chest; and, lastly, the sternum, clavicle, and ribs.

Fig. 259.



Aneurism of the innominate artery, proving fatal by bursting into the trachea.

The pressure of the tumor upon the subclavian has the effect of weakening the force of the circulation at the wrist, and in some cases even of entirely suppressing it. Occasionally, the pulse is extremely irregular, beating not only more feebly than that in the opposite limb, but ceasing to act synchronously with it, the blood hitching and halting, as it were, on its way to the hand. Any tumor may of course produce such an effect, and hence there is nothing characteristic in it. In aneurism of the aorta, the signs of enfeebled circulation are, as a general rule, most strongly marked on the left side, owing to the fact that the tumor, from its proximity to the left subclavian, exerts a more direct and controlling influence upon that vessel than it does upon the right subclavian. The pulsation of the carotid and its branches is sometimes diminished both in innominatal and aortic aneurism, but more frequently in the former than in the latter. It is, however, a rare occurrence in either case, and therefore of no diagnostic value.

Compression of the veins at the root of the neck, as the innominate, jugular, and subclavian, but especially the first, by impeding the return of blood to the heart, will occasionally cause *œdema* of the right side of the head, face, and eyelids, and of the corresponding limb, extending as low down as the hand and fingers. The occurrence, however, is uncommon, and it is probable that it may be due, in part, to injury sustained by the right lymphatic duct, situated just behind the tumor.

As the tumor enlarges, it necessarily encroaches more and more upon the trachea, pushing it over towards the left side, and at the same time somewhat backwards. When the displacement is considerable, the patient will breathe with difficulty, and will occasionally be unable to lie down, owing to the mechanical obstruction to the introduction of the air. Should the tumor be situated unusually low, or be of extraordinary size, it may compress and flatten the right bronchial tube. Dyspnœa from both of these causes, however, is less frequent in aneurism of the innominate artery than in aneurism of the arch of the aorta, owing to the fact that, in the latter disease, the tumor enlarges most in a backward direction, its progress forwards being interfered with by the sternum and clavicle. Displacement of the œsophagus is sometimes present in both affections, but not as often as has generally been supposed. When existing in a high degree, it may seriously embarrass the function of deglutition, especially the passage of solids.

When the aneurism occupies the inferior portion of the artery, but more especially when it extends downwards into the chest, it follows, as a necessary consequence, that it must press upon the aorta, heart, and vena cava, pushing them out of their natural position, and perhaps seriously diminishing their capacity. The particular effect which such compression must exert cannot always be diagnosticated, but it is reasonable to conclude that it will manifest itself in disordered circulation, especially in tumultuous and confused cardiac action, enfeebled pulse, and more or less dyspnœa. An aortic aneurism will of course be more likely to produce such a state of things than an innominatal.

Pressure of the tumor upon the *nerves* of the neck and chest induces not only pain and cough, but gives rise, in many cases, to severe dyspnœa and dysphagia, the two latter symptoms being not always, by any means, exclusively dependent upon the displacement and flattening of the trachea and œsophagus. On the contrary, they sometimes exist in a very marked and even in an aggravated degree when there is apparently very little, if any, compression of these tubes. We must therefore look for some other explanation of these phenomena, and the most plausible one that suggests itself is that they are due to the compression of the pneumogastric, phrenic, laryngeal, and sympathetic nerves, which are thus disqualified for carrying on their appropriate function, that, namely, of receiving and transmitting, in a regular and harmonious manner, their peculiar influence to the organs to which they are distributed, and in which they play so important a part in the natural state.

The *dyspnœa*, although not a constant symptom, is yet often enough present to render it one of great importance. It varies in degree from the slightest change in the natural respiration to the most frightful embarrassment, in which the patient is almost suffocated, and unable to maintain the recumbent posture. It is of course most severe and distressing when the tumor has acquired an unusual bulk, compressing the pneumogastric and other nerves, and so interrupting their healthy action. It may be constant, or paroxysmal, coming on at irregular intervals, lasting for some time, and then gradually receding, though perhaps at no time wholly absent.

The *dysphagia* is also variable in degree, being at one time very slight, and at another so severe as almost to prevent the patient from swallowing any kind of food, whether solid or fluid. In the more aggravated cases, the difficulty is constant, and the patient finally dies exhausted from starvation. It is a remarkable fact that in almost every case of dysphagia this symptom is preceded by dyspnœa.

The *pain* which accompanies the disease is most severe in the right side, in the situation of the tumor, from which it runs in various directions, particularly along the right side of the neck and head, and the corresponding side of the chest, shoulder, and arm. Occasionally, though rarely, it is also felt keenly on the opposite side. It is generally of a dull, aching, or gnawing character, and is often so excessive as to compel the use of large doses of anodynes for its temporary subjugation.

Cough is occasionally present, probably in one case out of every three or four, but it is less common than in aortic aneurism, and is a symptom of no special value. It is evidently produced by the pressure of the tumor upon the laryngeal nerves, and varies much in frequency and severity in different cases and under different circumstances. From the same cause there is sometimes an altered state of the voice.

When the tumor is very large, and extends outwards and downwards, so as to compress the cervical and brachial plexus of nerves, it may induce partial *paralysis*, as well as, in some cases, partial loss of sensation, in the upper extremity. Such an occurrence, however, is extremely rare, as the sac seldom attains such a magnitude.

There is sometimes marked alteration in the *respiratory sounds;* more frequently, however, in aortic than in innominatal aneurism. The breathing, when affected, is disposed to be stridulous, or wheezing, and this is sometimes the case even when the patient is in the erect posture. The respiratory murmur is seldom affected in innominatal aneurism, obviously because the tumor encroaches but little, if any, upon the lungs; it is only when it extends deep down into the thorax that it is likely to produce such an effect, and then, but not otherwise, there will, also, of necessity, be dulness on percussion of the chest, over the site of the disease. Both these phenomena are more frequent in aortic aneurism, because the tumor in that disease always encroaches more upon the lungs than in the former case.

Finally, the pressure of the tumor occasionally induces serious disease in the neighboring *bones*, as the sternum, clavicle, and first rib, the contiguous portions of which are liable, in the first instance, to be displaced, then to become carious, and ultimately to be wholly absorbed. In some cases there is complete dislocation of the sterno-clavicular joint.

Diagnosis.—After what has just been said, it will be easily understood that the diagnosis of innominatal aneurism must often be extremely difficult, its situation at the root of the neck rendering it liable to be confounded with aneurism of the arch of the aorta, the carotid, and subclavian. Then, again, certain tumors—fatty, fibrous, and encysted—sometimes form at the inferior portion of the cervical region, and receiving an impulse from the innominate, or even from the aorta itself, may thus simulate the disease in question. Finally, I have occasionally encountered great difficulty in determining the diagnosis of disease occurring in this situation in consequence of abnormal pulsation either of this vessel, or of the aorta, apparently dependent upon an anemic condition of the system, or neuralgia of the arteries, and so violent as to communicate a severe shock at every contraction of the left ventricle of the heart to the innominate and its two branches, the carotid and subclavian. The embarrassment, in these cases, is increased if, superadded to the pulsation at the root of the neck, there is an unusual quantity of fat, or some solid growth, and the sharp thrill so common in the arteries of anemic subjects.

On the whole, the most reliable diagnostic signs of aneurism of the innominate are, first, the situation of the tumor at the right sterno-clavicular joint, immediately above the inner third of the clavicle, where it forms a distinct, well-marked prominence; secondly, stoppage of aneurismal beat, thrill, and bellows' sound, by pressure upon the carotid and subclavian; and, thirdly, unnatural weakness of the pulse at the right wrist, with pain and œdema on the corresponding side of the neck, shoulder, and arm. In aortic aneurism, the tumor seldom projects sensibly above the sternum; certainly not before it has attained a considerable bulk, and then it is situated rather in the middle line than on the right side; the arterial pulse, if affected at all, is weakest on the left side, and there also the œdema and pain are most conspicuous; the dyspnœa, dysphagia, cough, stridulous respiration, and change of voice are more frequent than in the innominatal disease; and compression of the carotid and subclavian produces no diminution in the sounds of the tumor.

Prognosis.—The prognosis of brachio-cephalic aneurism is extremely unfavorable. The disease, it is true, may last for a considerable time, but this is very rare; in general, it progresses very rapidly, and soon reaches a fatal crisis, the tumor either opening externally, into the trachea, or into the chest, or else, as is commonly the case, wearing out the patient by constitutional irritation, asphyxia, or inanition. No instance of spontaneous cure has ever been known to occur in this disease.

Treatment.—The treatment of aneurism of the innominate has hitherto been most unsatisfactory. Owing to the short and stunted character of this vessel, and the close proximity of the aneurism to the arch of the aorta, deligation on the Hunterian principle is, of course, altogether impracticable, and hence the only resource is either to treat the disease upon the plan of Valsalva, or to tie the carotid and subclavian at the distal side of the sac, according to the method originally suggested by Brasdor. The treatment of the Italian surgeon holds out but little encouragement, the disease generally going on from bad to worse until it reaches its fatal crisis, despite the most abstemious course of dieting, rest in the recumbent posture, the use of the lancet, and the exhibition of digitalis, opium, and acetate of lead, to promote the formation of clots. With the exception of Mr. Luke's case, there is hardly an instance upon record in which it was followed by any ultimate benefit. Squeezing the tumor, if practicable, would certainly not be justifiable, as the detached clots might, and probably would, fall into the aorta, and thus cause serious, if not fatal, results on the spot, from mechanical obstruction to the circulation. The operation of Brasdor has been performed in a number of cases, which I shall place before the reader in tabular form.

In only one case have the carotid and subclavian arteries been tied simultaneously. The patient died at the end of six days. At the autopsy, the left carotid and right vertebral arteries were found occluded, showing that the circulation of the brain had been carried on by the left vertebral alone. Rossi was the operator.

In three cases, the carotid and subclavian have been successively tied, as recommended by Mr. Fearn, of Derby, England.

No.	Operator.	Sex.	Age.	Carotid ligature.	Subclavian ligature.	Remarks.
1	Fearn	F.	28	Aug. 30, 1836	Aug. 2, 1838	Died from pleurisy three weeks after second operation. The aneurismal sac was found filled with dense, organized coagula, except a channel the size of the artery for the passage of blood.
2	Wickham	M.	55	Sept. 25, 1839	Dec. 3, 1839	The aneurism increased, and burst with mortal hemorrhage 63 days after the second operation.
3	Malgaigne	M.	—	March, 1845	Oct. 17, 1845	Four days after the operation, the tumor increased rapidly in size, the tumefaction became diffused, and the patient died on the 7th Nov. At the autopsy, the sac could not be dissected; it was confounded with the muscles; in other words, the aneurism was diffused.

In four cases, the subclavian alone has been tied, with a result of three deaths and one recovery.

No.	Operator.	Sex.	Age.	Result.	Remarks.
1	Dupuytren	M.	40	Death	The subclavian was tied immediately above the clavicle. The tumor diminished, but the pulsations continued. The patient died on the 9th day, from exhaustion following cough and secondary hemorrhage. At the autopsy, aneurism of the subclavian was found, with dilatation of the innominate and aorta.
2	Laugier	M.	57	Death	The vessel was tied immediately above the clavicle. The patient died from asphyxia, one month after the operation. The operator had supposed the case to be one of subclavian aneurism.
3	Wardrop	F.	45	Recovery	The patient, cured of an aneurism occupying the upper part of the innominate, died two years after the operation, of a new aneurism formed above the first, apparently on the same trunk.
4	Blackman	—	—	Death	Tubular aneurism of the innominate and arch of the aorta; left carotid and subclavian obliterated; death on the eighth day from hemorrhage caused by jumping out of bed.

The carotid alone has been tied in eleven cases, of which two were cured, abd the rest died.

No.	Operator.	Sex.	Age.	Result.	Remarks.
1	Evans	M.	30	Recovered	The tumor still existed, with constant pulsation, at the end of a year. The next year, the sac suppurated, and discharged much pus. At the expiration of nine years, there was no sign of any increase in the affection.
2	Mott	M.	55	Died	After the operation, the tumor was much diminished; but the patient died of asphyxia seven months after the operation.
3	Dohlhoff	F.	—	Died	The aneurism was much improved, but the patient died from the effects of the ligature of the carotid upon the brain. At the autopsy, the aneurism was found occupying the external side of the innominate near its bifurcation; it was as large as the fist, and filled with fibrinous clots.
4	Key	F.	61	Died	The patient died a few hours after the operation from its effect upon the brain. The vertebral arteries were found smaller than natural.
5	Vilardebo	M.	70	Died	The patient was a negro. He died on the twenty-first day after the operation. At the autopsy, two aneurisms were found; one of the inferior extremity of the right primitive carotid, the other of the trunk of the innominate.
6	Fergusson	M.	56	Died	The patient died of pneumonia on the seventh day. The tumor had diminished, and, at the autopsy, was found nearly filled with firm laminated coagula.
7	Hutton	M.	47	Died	The size of the tumor and the pulsations diminished after the operation, but the sac inflamed, suppurated, and opened into the trachea, and the patient died on the sixty-sixth day.
8	Porta	—	—	Died	The patient died forty hours after the application of the ligature. The autopsy showed an arterial dilatation of the innominate and its two branches, without true aneurism.
9	Campbell	M.	48	Died	The tumor began to disappear after the vessel was ligated, but the patient died of pneumonia on the nineteenth day.
10	Morrison	M.	42	Recovered	The patient recovered from the operation, and died suddenly twenty months afterwards. The cause of death is not given. At the autopsy, the right carotid was found dilated in the form of a sac, and filled with a resisting fibrinous deposit. The brachio-cephalic trunk and curve of the aorta were found larger than usual, and the walls were diseased, but these vessels were not aneurismatic.
11	Wright	M.	70	Died	The patient died on the eighty-eighth day from hemiplegia. The tumor was solidified by fibrin, a canal leading through it to the subclavian. Four abscesses were found in the right hemisphere of the brain.

A careful examination of the above cases affords the following conclusions concerning the deligation of the primitive carotid for the cure of innominatal aneurism:—

1. It reduces the volume of the tumor. Thus, in the case of Mr. Evans, of Derby, in 1828, although the aneurism was as large as a walnut, it entirely disappeared in a little upwards of a month. In Dr. Mott's case, in 1829, it was of the size of a pigeon's egg, and disappeared in twenty-six days.

2. The operation leads to fibrinization of the contents of the sac. These changes, which are due, not to arteritis, but to remora of the blood, were well displayed in the cases reported by Mr. Morrison, of Buenos Ayres, in 1834, and of Mr. Fergusson, of London, in 1841. In the former, the innominate artery was reduced to at least one-half its previous bulk; in the latter, the tumor was nearly filled with firm clots.

3. The operation does not involve any *special* risk. In five of the cases it was followed by death, not, apparently, from any agency of the aneurism, but because of the danger which naturally follows the ligation of the common carotid, for whatever purpose. Thus, in the case of Mr. Key, in 1830, the patient died of syncope, produced by coarctation of the left carotid and ver-

tebral arteries. In two other instances, one by Fergusson, in 1841, and the other by Campbell, of Montreal, in 1845, death resulted from pneumonia. In Hutton's case, the cause of death was inflammation and ulceration of the sac, also a very common effect of the operation for carotid aneurism, whether the ligature be placed above or below the tumor. In the interesting case of Professor Wright, of Montreal, in 1855, the patient died of abscesses of the brain, the first example of the kind on record after Brasdor's operation, although severe cerebral symptoms often succeed the ligation of the common carotid for accidents and tumors of the head, eye, and face.

4. The operation has not been productive of a long after-life: chiefly, perhaps, because the cases demanding it were nearly all inherently hopeless, from being associated with organic disease of the aorta, or of this vessel and of the heart. Distinct evidence of this fact existed in at least seven of the cases; in the rest no accurate examination was made. The influence of such complications is shown by the results which followed Brasdor's operation in aneurism of the root of the carotid unmixed with any other lesion. Of five cases of this kind, three completely recovered; one was successful so far as the aneurism was concerned; and in only one was there no improvement.

5. The operation lengthens life if perilled by rupture of the sac, or pressure on the windpipe. In fact, here is its great triumph. In the case of Professor Wright, although the man was in imminent danger before the operation, yet he survived it eighty-eight days. The mean duration of life after deligation of the carotid, under ordinary circumstances, is about four months and a half.

6. The operation has occasionally failed to effect any local improvement. This result followed in three of the cases, in consequence of a want of fibrinization of the contents of the sac.

The facts above stated, deduced mainly from the paper of Professor Wright, in the Montreal Journal of Medicine, clearly point, as that gentleman justly remarks, to a division of cases in regard to the applicability of the operation. 1. The most suitable cases are those of uncomplicated innominatal aneurism, being akin to the pure carotid form, the sac, which is confined to the part of the vessel near the bifurcation, springing from the left segment of the artery, and not coexisting with degeneration of its tunics or cardiac disease. 2. Those imperatively requiring it are such as entail imminent danger from external rupture of the tumor or from other causes. 3. The most favorable cases are aneurisms proceeding from the left segment of the artery, because then the introduction of blood into the sac is most effectively impeded, as it is derived from the current destined for the vessel which is tied, whereas, when the aneurism is dextro-lateral, the same benefit cannot be afforded, as the supply is furnished by the subclavian. Next to this situation, the most preferable, anatomically, would be the origin of the tumor from the anterior circumference of the vessel. 4. The less advantageous cases are those in which the external tumor extends towards the middle of the clavicle, for this occurrence denotes such an engagement of the subclavian as must effectually counteract any benefit derivable from ligature of the carotid. When the swelling is equal on each side of the innominate, or symmetrical, then the only hope of a certain stasis of blood would be afforded by tying both branches. 5. The cases contra-indicating the operation are those having complications with aortic aneurism, or serious disease of the heart, unless excepted by extreme urgency.

ANEURISM OF THE COMMON CAROTID ARTERY.

Aneurism of the carotid, although less frequent than that of some of the other arteries, especially the popliteal and femoral, has, nevertheless, always attracted much attention, for the reason, probably, that its exposed situation in the neck has afforded unusual facilities for its observation and study. However this may be, its history is perhaps, on the whole, better understood than that of aneurism of any other artery. The relative frequency of the disease has been placed before the profession by several writers. Thus, in the table compiled by Lisfranc, comprising 179 cases of aneurism, exclusive of those of the aorta, 17 refer to the carotid, the subclavian having been affected in 16, the axillary in 14, the femoral in 26, and the popliteal in 59. In the table of Mr. Crisp, the carotid is stated to have been engaged in 25 cases out of 551, embracing 234 of the aorta, giving thus a considerably larger proportion than that of the French author.

Spontaneous aneurism of the carotid is more frequent in men than in women, but not by any means in the same relative proportion as spontaneous aneurism of the other arteries. Thus, in 34 cases analyzed by Dr. Norris, 27 were males, and 7 females, being in the ratio of nearly four of the former to one of the latter; a ratio which is altogether unequalled by that of any other vessel. An idea formerly prevailed that the disease occurred here with nearly equal frequency in both sexes, but such a conclusion is totally at variance with the facts of the case.

The disease, although occasionally observed at an early *age*, is most common between the thirtieth and the sixtieth year. It occurs with nearly equal frequency on both sides, and, in fact, sometimes exists simultaneously in both arteries. No occupation is exempt from it. One would suppose, from reflecting upon the peculiarity of their pursuits, that acrobats, who are in the habit of making such violent and long-continued use of their necks, often sustaining enormous loads upon their heads, would be particularly prone to carotid aneurism, and yet the disease is hardly known among them.

The *site* of carotid aneurism is variable. Sometimes the tumor is situated very low down in the neck, close to the origin of the vessel; on the other hand, it may be seated high up, near its bifurcation. In the great majority of cases, however, it will be found to be between these two points, at or near the middle of the artery; usually rather above than below.

Symptoms.—The tumor, when first observed, is generally quite small, perhaps not exceeding the size of a filbert, and of an irregularly globular, rounded, or ovoidal shape. The patient, upon being questioned as to the history of the case, usually expresses his ignorance as to the time of its occurrence, though occasionally he is rendered conscious of it by a peculiar stabbing sensation in the neck, or a feeling as if something had suddenly snapped asunder. Commonly the surgeon is not consulted until the tumor has made considerable progress, and acquired the volume of a hen's egg, or of a small orange, the patient, perhaps, having all along supposed that the swelling was merely an enlargement of some of the cervical ganglions. A careful inspection, however, promptly reveals its true character, its pulsation, thrill, and bellows' sound affording unmistakable evidence of its close and intimate arterial connection. Pressure upon the cardiac side of the aneurism, by stopping its circulation, arrests these symptoms, and causes a sensible diminution of the size and consistence of the tumor, while pressure upon its distal side produces an opposite result. As long as it is small, the tumor may readily be moved about, and even raised out of its bed, especially if it be grasped with the thumb and forefinger during the relaxed condition of the sterno-mastoid muscle; as it augments in volume it becomes more fixed in its position, and is eventually rendered almost, if not entirely, stationary.

The symptoms of carotid aneurism are altogether of a mechanical character, being such as arise from the pressure of the tumor upon the neighboring parts; hence, their gravity is generally in proportion to the volume of the morbid growth. In the earlier stages of the disease, there is either no functional disturbance whatever, or it is so insignificant as not to attract any special attention; by and by, however, as it progresses, the tumor necessarily encroaches more and more upon the delicate and important structures of the neck, thus occasioning congestion of the brain by retarding the return of blood in the jugular vein, numbness, pain, and cough, by compressing the cervical, pneumogastric, and phrenic nerves, and difficulty of respiration, and, perhaps, even of deglutition, by bearing against the trachea and œsophagus. The surface of the swelling, at first perfectly natural, becomes gradually indurated and inflamed, the subcutaneous veins are unusually conspicuous, and the neck is stiff, distorted, and almost immovable. The greatest enlargement of the tumor is generally in the direction of the median plane, as the resistance is much less there than externally, under the edge of the sterno-cleido-mastoid muscle.

Diagnosis.—Notwithstanding that the symptoms of carotid aneurism are usually well-marked, cases, nevertheless, occur in which they are so obscure as to render it extremely difficult to determine the diagnosis, even after the most careful and patient investigation. The affections of the neck which are most liable to be confounded with carotid aneurism, and to render the discrimination doubtful, are diseased lymphatic ganglions, abscesses, encysted tumors, goitre, dilatation of the internal jugular vein, and aneurism of the innominate artery and arch of the aorta.

Enlargement of the *lymphatic ganglions* of the neck is most common in young subjects, before the age of twenty, whereas aneurism of the carotid is rarely met with until after thirty; moreover, it is almost peculiar to scrofulous persons, while aneurism occurs in all classes of individuals, the strumous and the non-strumous. In aneurism the tumor is generally well-defined; its surface is smooth and uniform, and the swelling heaves and throbs, as if it were alive. In glandular enlargement, there is generally a chain of diseased ganglions, either scattered about in different parts of the neck, or stretched along the inner border of the sterno-cleido-mastoid muscle; the tumors feel hard, and may, with a little care, be easily separated, not only from each other, but from the carotid artery, so as to get entirely beyond the reach of its pulsation.

Aneurism of the carotid artery has sometimes been mistaken for *abscess;* the tumor has been punctured, and the patient has speedily perished of hemorrhage. Such an error, of course, implies great carelessness, and could hardly happen at the present day when our means of diagnosis are so much more perfect than formerly. The discrimination must be determined on general principles. If there be an abscess, the history of the case, conjoined with the unnatural heat and redness of the part, the rapid progress of the swelling, the febrile disturbance, and the absence of the characteristic pulsation, thrill, and bellows' sound, will be sufficient to distinguish it from aneurism of the carotid artery.

Encysted tumors, usually containing a serous or sero-sanguinolent fluid, are liable to form at the front and sides of the neck, most generally in connection with the thyroid gland, but sometimes independently of it, in the cellular tissue beneath the muscles. They can usually readily be distinguished by their slow growth and fluctuating feel, the absence of pain and pulsation, and, when they are attached to the thyroid gland, by their obeying the movements of the larynx in the act of deglutition. If, after a careful examination of their history, any doubt exists as to their real nature, the only resource will be the cautious introduction of the exploring needle.

Goitre is liable to be mistaken for carotid aneurism only when it spreads laterally over the neck, so as to overlap the carotid, and receive its pulsation. It is certainly not possible to commit any error of diagnosis in the more ordinary and simple forms of the disease. Confusion is most apt to arise when aneurism and goitre co-exist, or when, as occasionally happens, the latter disease is developed uncommonly rapidly, and is attended with considerable local distress. Ordinarily, goitre forms in early life, at a period when aneurism is extremely infrequent; its progress is generally tardy, several years elapsing before it attains any material bulk, and is subject to occasional interruptions, and even total suspension, whereas aneurism generally advances rapidly and steadily, the symptoms proceeding from bad to worse, until it attains its crisis. Another important criterion is the fact that goitre is almost peculiar to females, whereas carotid aneurism occurs by far most frequently in men. But the most satisfactory diagnostic signs are, first, that, in goitre, the tumor obeys the movements of the larynx, whereas, in aneurism, it remains stationary, however strong the efforts at deglutition; secondly, that, in the former, the tumor may be drawn away from the vessel, raised up or pushed to one side, while in the latter the vessel follows it, forming, as it does, a part of it; and, lastly, that in goitre the general health rarely suffers, even when the tumor is of large bulk, whereas in aneurism it is always more or less impaired, especially when it has reached such a stage as to be likely to occasion embarrassment in regard to the discrimination between the two affections.

A dilated condition of the internal *jugular vein* may simulate aneurism of the carotid artery. The deception will be more likely to happen if the vein receives a pulsatory movement from the heart or from the carotid, as when the artery is overlapped by the vein. The venous tumor may generally be distinguished by its softness and compressibility, by its situation, which is commonly just above the sternum, and rather behind than in front of the mastoid muscle, and by the circumstance that its motion is more of an undulatory, wave-like, or tremulous character, than shock-like and vibratory, as in aneurism. Superadded to this is the fact that the venous swelling may be readily effaced by pressure applied to its distal extremity, whereas, in aneurism, the pressure, to produce any appreciable effect of this kind at all, must be applied to the cardiac extremity of the tumor, and then it will result only in a diminution, not in complete obliteration.

Finally, a carotid aneurism may be confounded with aneurism of the *brachio-cephalic artery* or of the arch of the aorta, especially if it be situated low down in the neck. When this is the case, the difficulty may be very great, if not insurmountable. The best diagnostic sign with which I am acquainted, and one that will rarely fail us, in such an emergency, is afforded by our ability to insinuate the point of the forefinger between the top of the sternum and the lower extremity of the aneurism, while the head is being bent powerfully forwards, so as to relax as fully as possible the mastoid muscles. If this can be done, the probability is that the tumor is connected with the carotid; otherwise we may conclude that it is formed by the innominate artery, or by the arch of the aorta.

Progress.—The progress of carotid aneurism, although usually rapid, is not so always. The annals of surgery contain several cases where the disease remained almost stationary for a considerable number of years; in one instance as many as fourteen. A spontaneous cure sometimes occurs, but such an event must necessarily be extremely rare. The tumor, if allowed to go on unchecked, eventually—generally at a period varying from three to twelve months—destroys life either by excessive constitutional irritation, hemorrhage, gangrene, pneumonia, or asphyxia. When seized by ulceration, it may burst either externally, or it may open into the pleura, the anterior mediastinum, the trachea, or one of the bronchial tubes.

Treatment.—The treatment of carotid aneurism is generally conducted according to the Hunterian principle of ligating the supplying vessel at the cardiac side of the tumor; and, fortunately, as the disease is ordinarily situated rather high up, this may commonly be done without any very great difficulty, especially in the earlier stages of the affection, before the swelling has attained much bulk. When the tumor is of great size, or located at the inferior part of the neck, we may be compelled to adopt the method of Brasdor, and tie the carotid on the distal side of the aneurism, trusting that the blood in the tumor, no longer finding an outlet, will gradually coagulate, and so effect its obliteration. The fact is, this artery, owing to the total absence of collateral branches, is peculiarly adapted to this operation, and it is well that it should be so, seeing that, if it were otherwise, we should be obliged to resign many of the more severe cases of carotid aneurism to their fate, without any attempt whatever at surgical interference. It is obvious, from the relations of the vessels and nerves of the neck to the tumor, that compression, now so much employed in the treatment of aneurism of the lower extremity, cannot be brought in play here, the parts being intolerant of the requisite manipulation, to say nothing of the obstruction which it would occasion to the return of the blood in the internal jugular vein, which, being dammed up in the brain and the sinuses of the dura mater, might speedily induce apoplexy, and other serious cerebral symptoms, endangering the patient's life. When the tumor is of extraordinary bulk, rendering ligation of the carotid impracticable at any point, our only hope, faint though it be, is the success of general measures, particularly Valsalva's method, for experience has conclusively proved that no benefit is to be expected from the ligation of the innominate artery, as originally proposed and practised by Dr. Mott. The deligation of the terminal branches of the carotid might be tried with a better prospect of success, but this also would be likely to fail, owing to the numerous offsets of the external carotid, which, unless included in separate ligatures, would continue to transmit the blood from the tumor with sufficient force and activity to maintain its circulation unimpaired, and so inevitably frustrate the intentions of the operation.

When the tumor is unusually voluminous, or even of moderate size, but situated very low down, overlapping and compressing the trachea, the symptoms may be so urgent as to demand the operation of laryngotomy, to save the patient from impending asphyxia. Such an event must, however, be very uncommon.

A very interesting case of carotid aneurism has been related by Dr. Robertson, of Edinburgh, in which he performed an operation after the tumor had burst into the œsophagus. The swelling was situated so low down that he was compelled to ligate the vessel only half an inch above its origin from the innominate artery. Notwithstanding these unfavorable circumstances, the patient made an excellent recovery, the ligature coming away on the seventeenth day.

The operation of tying the carotid is easy enough in ordinary cases, but when the aneurism is large, or the neck very short and fat, it is one of the most difficult and trying undertakings in surgery. The principal accidents likely to attend it are the inclusion of the jugular vein and pneumogastric nerve in the ligature, and the wounding of some of the smaller vessels of the neck, which it is sometimes more difficult to find and secure than the carotid itself.

Mortality and other Effects.—Of the mortality of the operation for carotid aneurism, a tolerably accurate estimate may be formed from the data now before the profession. Of 21 cases mentioned by Mr. Crisp, 10 were successful, and 11 fatal. In 5, the artery was ligated at the distal side of the tumor, and of these, 3 recovered, the other 2 being only somewhat benefited. Of the 11 fatal cases, 5 were lost by hemorrhage, 2 by inflammation of the sac and artery, and 1 by spasm of the glottis, the cause of death in the remaining 3 being doubtful. The table of Dr. Norris contains an analysis of 38 cases, in which the carotid was tied for aneurism, including 4, however, in which the disease was found, after the operation, not to have been connected with the artery. Of these cases, 22 recovered, and 16 died. The cause of death is mentioned in only 12 of the cases; in 5 it was hemorrhage, in 2 inflammation of the sac, in 2 apoplexy and congestion of the brain, in 1 cerebritis, in 1 spasm of the glottis, and in 1 exhaustion.

In 6 of the 38 cases, the aneurism suppurated, and either burst or was laid open; of these, 4 died and 2 recovered. In one instance the opening in the sac occurred four months, and in another nearly eight months, after the operation. In one fatal case the tumor burst into the pharynx fifteen days after the deligation of the artery, and in another case, which, however, recovered, it had discharged some of its contents into the mouth prior to the operation.

Return of *pulsation* in the tumor, after the operation, was noted in nine of the thirty-eight cases; in one the pulsation never ceased entirely for two months, and in another it continued for upwards of four months.

The detachment of the ligature occurred, in 13 cases, before the twentieth day; in 7, between the twentieth and thirtieth, and in 1 on the thirty-third day. The time, in the remaining cases, was not observed.

In seven of the cases, analyzed by Dr. Norris, there was a mistake in the diagnosis, as was proved on the dissection, for all the patients died. In four, the disease consisted of different kinds of tumors; in two, of aneurisms supposed to be abscesses; and in one, of an aneurism of the vertebral artery. The examples of mistaken diagnosis include the celebrated case of Mr. Liston, of a lad, nine years of age, who had a tumor on the right side of the neck of two months' standing, which, although seated over the carotid, was entirely free from pulsation, except along the track of that vessel. Under the conviction that it was merely an abscess, a bistoury was introduced, the removal of which was followed by a gush of arterial blood to the amount of four ounces. The bleeding being arrested by closing the wound with the twisted suture, the common carotid was tied on the following day, October 21st, close to its origin from the innominate artery. On the 3d of November, the arterial hemorrhage suddenly recurred, but was suppressed by plugging the wound with lint; it, however, again broke forth, and proved fatal on the 5th, that is, fifteen days after the operation. Although the ligature had retained its hold upon the artery, the proximal end of the vessel was found to be quite patulous, no attempt having been made at the formation of a coagulum. The probability is that, as Mr. Liston has suggested, the tumor, in this remarkable case, was originally a scrofulous abscess, a part of the wall of which was formed by the carotid; the latter, becoming ulcerated, finally gave way, and thus sent its contents into the cyst inclosing the matter.

Injury to the internal jugular vein has been a cause of death in several cases of ligation of the carotid. In an instance in which Barovero included this vessel with the artery, the patient died on the sixty-ninth day of gastric fever. Mr. Crisp met with a case where a surgeon tied the internal jugular vein instead of the carotid; the patient was a child, and the error was not discovered until after death.

Very serious cerebral and pulmonic symptoms occasionally follow the ligation of the carotid artery, and are among the principal sources of the mortality from this operation. The effects which the operation produces upon the *brain* have been elucidated both by experiments upon the inferior animals and by observations upon the human subject, and manifest themselves in various ways and at different intervals. Their full importance, however, was not known until after the publication of the researches of Mr. Chevers, of London, in 1845, to whom the profession is greatly indebted for the valuable light which he has thrown upon a subject which, up to that period, had been entirely overlooked. In the one hundred and twenty-five cases analyzed by Dr. Norris, in which the common carotid was tied either for aneurism, wounds, or erectile tumors, more or less severe cerebral disturbance occurred in thirty. Some of these cases recovered completely, some got well of the operation, but remained afterwards in a crippled condition, and some, perhaps the majority, died, the period of death varying from a few hours to several months.

There is no uniformity either in the character or in the manifestation of the cerebral symptoms. Sometimes they come on immediately, or at all events, within a few hours after the deligation of the vessel; while at other times, and perhaps most generally, they do not appear until the end of several days, weeks, or even months. Their access is usually sudden, but occasionally so gradual and imperceptible as to keep the patient in ignorance of it until it is discovered accidentally. The most frequent symptoms, on the whole, are convulsions and paralysis. The former are sometimes general, but much oftener partial, affecting, for example, one arm, a leg, or one side of the face; in some cases, there are merely spasmodic twitches, or irregular, involuntary movements. The paralysis occasionally exists on the side of the affected artery, but in most cases it occurs on the opposite side, when it sometimes pervades one-half of the body, as in hemiplegia, though generally it is only of limited extent, being confined, perhaps, to the face, tongue, throat, fauces, eyelid, hand, arm, leg, or thigh. Sometimes there is dimness of vision, with or without dilatation of the pupil; a feeling of drowsiness, somnolency, stupor, or coma; dizziness, vertigo, or headache; noise in the ears or partial deafness; delirium, either alone or conjoined with paralysis or convulsions; difficulty of deglutition; dyspnœa; a sense of coldness, or coldness and numbness; and various other symptoms, mostly of an anomalous, nervous character. Occasionally these effects rapidly disappear, but in general they are more or less persistent, and in some cases they remain up to the moment of the death of the patient. In some instances, inflammation of the brain, or of the brain and its envelops, supervenes, either soon after the deligation of the vessel, or at a more or less remote period.

How are these phenomena produced? Are they caused merely by an inadequate supply of blood to the brain, or are they the consequence solely of a loss of equilibrium in the cerebral circulation? To these questions it is of course impossible to return anything like a definite answer. It would seem probable, from the free anastomosis which exists between the branches of the internal carotid arteries, on the one hand, and between these arteries and the vertebral, on the other, that they could not be occasioned by a mere want of blood, inasmuch as these vessels are capable of furnishing the organ with an abundant supply of that material for the purpose of carrying on its healthy functions. Nevertheless, it is not unlikely that unpleasant effects may and do follow the sudden withdrawal of a certain quantity of blood from the brain, resembling those produced by copious bleeding at the arm, or by a smart concussion of the brain. In some instances, it is reasonable to conclude that they are the result of the inclusion of an important nerve; while in another class of cases, as when several weeks or months elapse before their supervention, they would seem to be the direct consequence of inflammation. Under the latter circumstances, dissection reveals softening of the cerebral substance and effusion of serum, or of serum and lymph, in the ventricles and upon the surface of the brain.

The most constant *pulmonary* effects occasioned by the ligation of the carotid artery are cough, bronchitis, and inflammation of the pulmonary tissue. Cough is not only a very frequent occurrence, but often one of great severity, rendering it sometimes extremely difficult to check it. It generally comes on soon after the operation, in fits of a violent spasmodic character, in which the patient is in the deepest distress, looking and acting as if he were about to be suffocated. Its duration is variable; sometimes lasting only a few hours, while at other times it continues, as a prominent symptom, for days together. When very severe, it may occasion hemorrhage in the wound, by reopening some of the vessels.

It is not easy to determine how this cough is induced. From the fact that it often follows immediately upon the operation, it is not unlikely that it may arise from the inclusion in the ligature of some nervous filament, which thus sets up irritation in the mucous membrane of the air-passages, especially of the larynx and trachea, causing an effect not dissimilar from that awakened by the sudden intromission of a drop of water into the windpipe. That the effect must be somewhat of this character would seem probable, when we reflect upon the spasmodic and uncontrollable nature of the cough which generally characterizes the attack. At other times, the cough may be purely sympathetic, or, what is more likely, may be caused by the compression of the filaments of the tri-splanchnic nerve, which are so abundantly distributed through the coats of the arteries, especially those about the neck and chest.

The effects which the ligation of the carotid exerts upon the bronchia and lungs set in at various periods after the operation, and are denoted by the usual rational and physical signs. On dissection, the mucous membrane of the former is found to be of a reddish color, either uniformly, or in patches, greatly engorged with blood, and covered with pus, or pus and lymph. The lungs are abnormally vascular, loaded with black blood, more or less hepatized, or solidified at one point and softened at another. Blood and pus are sometimes contained in the anterior mediastinum ; the pleura has been known to be the seat of extensive effusions ; now and then there are traces of inflammation of the larynx and trachea ; and occasionally, though rarely, the examination reveals the existence of pericarditis and endocarditis. When the inflammation of the respiratory organs is at all considerable, the blood drawn during life generally evinces a buffed, if not also a cupped appearance.

Such being the effects which are liable to follow, probably in one case out of every four or five, in the brain and lungs, in consequence of the deligation of the carotid, it is obvious that they should be carefully looked for, in order that proper measures may be adopted for their prompt and efficient removal the moment they arise. Much may be done, in most instances, by way of prevention, by a judicious preparatory course, consisting of venesection, purgatives, light diet, and repose of mind and body, which cannot fail to contribute materially to the protection both of the brain and lungs. The operation having been performed, these organs are most sedulously watched, the least indication that arises being met by appropriate means ; and in this way, the case is safely conducted to a favorable issue. If the patient be pale and faint, alcoholic stimulants, cautiously and judiciously administered, will be of service ; cough and convulsive symptoms are treated with anodynes and antispasmodics, particularly morphia ; and inflammation is controlled by the lancet, leeches, blisters, purgatives, aconite, and antimonials.

ANEURISM OF THE EXTERNAL CAROTID.

Spontaneous aneurism of the external carotid is perhaps still more uncommon than that of the internal carotid ; its history, consequently, is involved in obscurity. The situation of the tumor just below the angle of the jaw, its throbbing, pulsatile character, and its gradually increasing volume, would serve to distinguish it from ordinary growths in this portion of the cervical region.

ANEURISM OF THE OPHTHALMIC ARTERY.

Aneurism of this artery is rare, both as a traumatic and as a spontaneous affection. The former is usually caused by severe injury, and is apt to be followed by excessive enlargement of the structures of the orbit with protrusion of the eye. A number of cases of spontaneous aneurism of this artery are upon record, in only a few of which, however, the nature of the disease has been verified by dissection. Aneurism by anastomosis is also sometimes met with. The progress of aneurism of the ophthalmic artery is usually slow, and the symptoms are always characteristic. The proper remedy is ligation of the common carotid artery as early in the disease as possible, before there is any serious structural change in the parts. Of four cases treated in this way, and recently reported by Mr. Thomas Nunneley, of London, three proved successful, the other having perished from hemorrhage on the sixteenth day. In anastomotic aneurism, a cure has occasionally been effected by injection of perchloride of iron; and lately several cases have been successfully treated by digital compression of the carotid.

ANEURISM OF THE INTERNAL CAROTID.

Aneurism of the internal carotid has been observed only in a few instances, its deep situation at the side of the neck and its exemption from ossific and fatty degeneration serving to protect it from this disease. The diagnosis must necessarily be obscure, and is generally only determined after death. The London and Edinburgh Monthly Journal of Medicine and Surgery, for 1842, contains the particulars of a remarkable case of aneurism of this vessel observed by Mr. Syme. The patient, a woman aged sixty, had had a tumor for about five months in the throat, in the usual situation of abscess of the tonsil. It had attained about the size of a large walnut, exhibited a diffused appearance when viewed through the mouth, and pulsated in a strong and characteristic manner in every portion of its extent. The ligation of the common carotid artery diminished, but did not completely arrest, the throbbing. The woman died in thirty hours after the operation without any assignable cause. Had a less careful surgeon had the management of this case, he might probably have punctured the tumor under the supposition of its being an abscess, and thus instantly hurled his patient out of existence, much to his own discredit and that of the profession.

ANEURISM OF THE VERTEBRAL ARTERY.

Aneurism of this artery, both spontaneous and traumatic, is extremely uncommon, a circumstance no doubt due to the deep situation of this vessel and to its freedom from ossification. In two very interesting cases of this disease, described by Ramaglia, of Naples, and South, of London, the diagnosis was so obscure that the true nature of the disease was not detected until after death. In both the common carotid was tied, without, of course, any benefit. In the former, which was an example of traumatic aneurism, situated behind the left ear, the operator, finding that the deligation did not arrest the pulsation, removed the ligature and treated the case upon general principles, death occurring soon after. In the other instance, in which the carotid artery could be distinctly traced over the tumor, this vessel was also tied under the supposition that it was the seat of the swelling. The tumor, however, rapidly increased, and in a fortnight after caused death by bursting into the trachea. Dissection showed that it was an aneurism of the vertebral artery, situated between the transverse processes of the fourth and fifth cervical vertebræ.

Möbus, a German surgeon, has reported a case of aneurism of the vertebral artery, the result of a wound of the neck, in which a cure was effected by compression and the use of ice.

ANEURISM OF THE SUBCLAVIAN.

Statistics prove that aneurism of the subclavian is nearly as frequent as that of the carotid. In Lisfranc's table the popliteal comes first, then the femoral, next the carotid, and then the subclavian, the latter having suffered in 16 cases out of 179. In the table of Mr. Crisp, comprising 295 cases of external aneurism, the subclavian was engaged in 23, and the carotid in 25. The disease is more frequent in the right artery than in the left, in men than in women, and in the laboring than in the higher classes. The period of life during which most of the cases occur is between the thirtieth and fiftieth years.

The disease may affect any portion of the artery, but is most frequent beyond the scalene muscles, a short distance before it becomes merged in the axillary. The form of the aneurism is generally globular or ovoidal, but cases are observed in which it has a singularly compressed appearance; and, on the other hand, it may be remarkably lobulated, especially when it is very capacious, and extends deeply among the surrounding structures, which thus indent its surface. Its volume is seldom very large, unless it becomes diffuse, when it may attain an enormous magnitude, reaching nearly up to the angle of the jaw, pushing out the clavicle, overlapping the trachea, displacing the scapula, pressing backwards against the ribs and spine, and dipping into the cavity of the chest so as to force down the lung and impede respiration.

As the tumor enlarges, it necessarily encroaches upon and compresses the neighboring parts, causing more or less pain, œdema, difficulty of respiration, dilatation of the veins of the neck, chest, and upper extremity, and a feeling of numbness and sometimes even partial paralysis. Originally small, deep seated, circumscribed, indolent, and movable, it generally steadily augments in volume, approaching, as it does so, nearer and nearer to the surface, loses its defined shape, becomes the seat of incessant pain, and at length contracts firm adhesions to the surrounding structures, identifying itself, as it were, with them. Examined with the ear and hand, it readily imparts to them the peculiar beat, thrill, and bellows' sound so characteristic of aneurism in other regions.

Diagnosis.—The diagnosis of subclavian aneurism is sometimes extremely difficult, and several cases have been reported in which the vessel was ligated where no disease of the kind existed. The affections with which it is most liable to be confounded are aneurism of the innominate artery or arch of the aorta, abscesses, and various kinds of tumors, solid and encysted, benign and malignant. As these lesions are of frequent occurrence in this region, it is impossible for the surgeon to be too cautious in his examination of cases involving questions of diagnosis.

The history of the tumor and its situation at the side of the neck, just above the clavicle, generally afford important data in regard to the diagnosis. If the patient is under thirty years of age, it may almost certainly be assumed that the disease is not spontaneous aneurism, as there are probably not three well-authenticated cases on record in which the subclavian was thus affected at this early period. Aneurism of the innominate is situated lower down, and approaches nearer to the middle line, than aneurism of its subclavian division; and in aneurism of the aorta, the tumor, although it may extend into the neck, rarely projects as far above the clavicle as in the lesion in question; certainly not in its earlier stages, when alone a correct diagnosis can be of any avail in an operative point of view. If the case be seen soon after its commencement, before the tumor has attained any considerable bulk, a very good idea may often be formed as to the precise portion of the artery that is affected by it. Thus, for example, if the aneurism occupies the space immediately exterior to the sterno-cleido-mastoid muscle, and manifests a tendency to extend upwards into the neck, and downwards in the direction of the axilla, it may be assumed that it is seated upon the outer portion of the vessel, beyond the scalene muscles. On the other hand, it may be concluded that it is connected with the inner portion of the artery, if the tumor is placed under cover of the mastoid muscle, and is gradually making its way over towards the median line, thus leaving the inferior triangle of the neck clear. It may be added that in subclavian aneurism the tumor is less liable to encroach upon the windpipe and œsophagus than in innominatal and aortic aneurism, and hence there is generally much less cough, dyspnœa, and dysphagia in this than in the other affections. It is only, in fact, when the tumor is of great bulk, or when it happens, from the peculiarity of its position, to exert much pressure upon the pneumogastric, phrenic, and laryngeal nerves, that any serious symptoms of this kind will be likely to arise.

Progress.—Subclavian aneurism is always a serious disease, a spontaneous cure, although possible, as several cases upon record testify, being an extremely rare occurrence. In general, the disease progresses until it attains a certain point of development, when it terminates fatally, either by ulceration and hemorrhage, or by the induction of constitutional irritation. The sac may open externally, a not uncommon event, especially when it is invaded by gangrene; or it may burst into the pleura, lungs, trachea, or œsophagus; in either case, death takes place either instantly or within a short time after the tumor has begun to give way. There are several cases on record in which the aneurism pointed in the axilla and on the shoulder, having completely eroded some of the upper ribs and the body of the scapula, the latter being scooped out so as to form a kind of bed for the accommodation of the sac.

Treatment.—The treatment of subclavian aneurism has hitherto been exceedingly unsatisfactory, and there is no probability, judging from the deep situation and intricate relations of the tumor, that much benefit will ever accrue from any mode of management that may be devised for its relief. The plan of Valsalva, varied in every possible manner, has signally failed in every instance except a few, and no one seems now disposed to place any confidence whatever in its efficacy. Acupuncturation and electricity, from which so much benefit had at one time been anticipated, have likewise disappointed expectation. Some time ago a case was reported in which a cure was alleged to have been effected by galvano-puncture, but the example is a solitary one, and the procedure is of too problematical a character to merit serious attention. Of what resource, then, can the surgeon avail himself in this unfortunate class of cases? Ligation of the affected artery is not only difficult, under any circumstances, in consequence of the position of the tumor and the intricacy of its anatomical relations, but is frequently absolutely impracticable on account of the diseased state of the artery, rendering it unable to support the ligature. Shall he adopt the operation of Dr. Mott, and secure the innominate, of which the subclavian, on the right side, is one of the main divisions? Here, again, difficulties meet in every direction, for even if he should be so fortunate as to get his ligature around the vessel, which, however, is by no means always the case, he will find, by consulting the history of the operation, that every instance in which it has been performed has had a fatal termination. Nothing, therefore, is to be gained from that procedure. In short, the Hunterian principle of operation is hardly applicable to any case of subclavian aneurism. On the right side, we are not only obliged to encounter, as just stated, great difficulties in reaching the innominate artery, but in throwing a ligature around the vessel we effectually cut off a large and important supply of blood to the brain, thus greatly enhancing the dangers of the case.

The innominate artery has been tied for the cure of subclavian aneurism in nine cases, the results of which are here subjoined in tabular form.

Ligation of the Innominate Artery.

Operator.	Date.	Age.	Sex.	Disease.	Result.	Remarks.
Mott	1818	57	M.	Subclavian aneurism	Died on 26th day	Artery tied half an inch below its bifurcation; ligature separated on the 14th day; hemorrhage on the 9th, and again on the 23d day; death on 26th day. Ulceration of the artery, and want of occlusion.
Graefe	1822		M.	Subclavian aneurism	Died on 67th day	Ligature came off on 14th day; death from hemorrhage.
Norman	1824				Died	
Arendt	1824			Subclavian aneurism	Died on 8th day	Cause of death, inflammation of the aneurismal sac and of the pleura and lungs.
Hall	1830	45	M.	Subclavian aneurism	Died on 5th day	Artery morbidly adherent; dilated, soft, and friable; torn, in the attempt to separate it, at two points, between which the ligature was applied; copious hemorrhage during operation; plugging of the wound; participation of the aorta and carotid in the disease.
Bland	1832	31	M.	Subclavian aneurism	Died on 18th day	Ligature placed around artery near its bifurcation; hemorrhage on the 17th day, proving fatal on the 18th; innominate and carotid closed by solid clots; the subclavian still open.
Lizars	1837	30	M.	Subclavian aneurism	Died on 21st day	Ligature separated on 17th day; pleuritis; death caused by repeated hemorrhages; twenty ounces of coagulated blood at the root of the neck; arteries imperfectly closed.
Hutin	1842	26	M.	Hemorrhage after ligature of subclavian	Died in 12 hours	Tied for secondary hemorrhage, after subclavian had been secured for wound of the axillary.
Cooper	1860	31	M.	Subclavian aneurism	Died on 41st day	Ligature, applied an inch from the aorta, detached on 18th day; patient did well for three weeks, when hemorrhage occurred, and finally caused death.

All the cases in the above table, except one, proved fatal from hemorrhage of the wound, caused by the want of occlusion either of the ligated artery, or of the carotid and subclavian. It will be observed that Graefe's patient survived upwards of two months. I purposely exclude from the table the cases which are usually referred to as having occurred in the practice of Dupuytren and Bujalski, not considering them as sufficiently well authenticated to entitle them to a place in it. I also reject from it several reported cases in which the operation of ligating the innominate artery was commenced but not completed.

Dr. Peixotto, of Portugal, tied the innominate artery in 1851, on account of secondary hemorrhage from the common carotid, which had been ligated three weeks previously. The ligature, however, which was a precautionary one, was not tightened, but applied merely so as to flatten the vessel. The patient made a good recovery. Such an operation can hardly be regarded as a true case of deligation of the innominate artery. The cure was doubtless effected by the ligation of the other vessel.

Mr. Key, of London, in a case of aneurism of the subclavian, found it impracticable to apply a ligature to the innominate, in consequence of the volume of the tumor, and the diseased condition of the latter vessel. The patient was seized soon after the operation with symptoms of pulmonary distress and exhaustion, and died on the twenty-third day.

The operation of ligating the innominate artery is one of no inconsiderable difficulty, even in the dead subject, but in the living the perplexity is greatly increased by the proximity of the aneurism, by the presence of glandular swellings, and, above all, by the manner in which the parts at the root of the neck are matted together by plastic deposits, rendering it thus exceedingly troublesome to separate them. These embarrassments were experienced in a striking degree by Dr. Hall, of Baltimore; he had great difficulty in isolating the vessel, and, in attempting to do so, tore it at two points, ligating it afterwards between them. Hemorrhage occurred at the time, but was checked by plugging the wound. Another obstacle to successful deligation is disease of the vessel, consisting either in a morbid dilatation, or in a softened and lacerable condition of its coats. Unforeseen difficulties were present in more than one-fourth of the cases in which ligation of the artery has been attempted, compelling the operators to desist, notwithstanding their great dexterity and profound knowledge of the anatomy of the neck.

Mr. Porter, of Dublin, in 1831 attempted to tie this artery on account of aneurism, but was obliged to desist in consequence of its diseased condition. The tumor, nevertheless, gradually disappeared, and the patient, a man forty-seven years of age, finally recovered.

Dr. Hoffman, of New York, in a case of subclavian aneurism in a man, aged sixty-three, cut down upon the innominate artery with the design of applying a ligature to it, should he be unable to ligate the subclavian; but he found the vessel so much enlarged that it was deemed inexpedient to proceed any further, and the patient was accordingly abandoned to his fate. The operation was performed on the 26th of October, 1839, and death occurred on the 19th of January, 1840.

The proposal to ligate the innominate originated with Mr. Allan Burns, from a conviction that the circulation in the head and upper extremity could be maintained without the agency of this vessel, and that it could be easily enough exposed by tracing it downwards towards the aorta, by a careful and patient dissection, the head being at the time bent well back. It remained, however, for Dr. Mott, in 1818, to put the suggestion to the test of experiment upon the living subject; and, although the operation had an unfavorable issue, the man dying, as has already been stated, on the twenty-sixth day, yet we cannot but admire the genius which could plan, and the intrepid skill which could execute, so daring and brilliant a feat. The case was one of subclavian aneurism above the clavicle, and the design had been to apply the thread to the latter vessel, but after exposing it on the tracheal side of the scalene muscle, it was found that its tunics were too much diseased to bear the pressure of the ligature, and he accordingly tied the innominate in its stead.

In a case of subclavian aneurism, Dupuytren tied the axillary artery under the pectoral muscles. Hemorrhage, or, rather, oozing of blood commenced on the fifth day, and the patient died on the ninth.

In another case the same operation was performed by Pétrequin. The tumor continuing to pulsate, the sac was punctured, and eight or nine drops of a solution of the perchloride of iron were injected, the brachio-cephalic trunk being compressed during the injection, and for ten minutes afterwards. The next day all pulsation had ceased in the tumor, but the patient died of hemorrhage at the place of the ligature, twelve days after its application.

Finally, benefit may occasionally arise in subclavian aneurism from *manipulation* of the tumor, as practised by Mr. Fergusson; some of the clots detached in the operation may accidentally find their way into the distal extremity of the vessel, and thus occlude its caliber along with the interior of the aneurismal sac. In a disease so desperate as this is known to be, and in which every expedient hitherto devised has been tried in vain, any suggestion that holds out the least possible chance of relief is worthy of trial.

ANEURISM OF THE AXILLARY ARTERY.

Aneurism of the axillary artery is less frequent than that of the subclavian. In 364 preparations of aneurism in the London museums, examined by Mr. Crisp, including 249 of the aorta, the axillary artery was affected only 8 times. In 551 cases analyzed by him from different sources, including 234 cases of aneurism of the aorta, 18 only were of the axillary artery.

The disease is, out of all proportion, most common in men; it follows upon different occupations, and is most frequently met with between the ages of thirty-five and fifty. In very many of the cases it is of traumatic origin. The volume of the tumor ranges from that of an egg to that of a child's head, the average being that of a goose-egg.

Symptoms.—The symptoms of axillary aneurism are generally so well marked as to render it impossible to mistake their character. When the disease arises spontaneously, or without any assignable cause, it may exist for several months without attracting any particular notice, and the same thing occasionally occurs when it results from external violence, as a blow or strain. Generally, however, the tumor rapidly augments in bulk, and produces such a train of phenomena as to lead at once to its detection. Of these, one of the earliest, and at the same time most unpleasant, is the sense of fatigue or uneasiness in the affected part arising from the pressure on the axillary plexus of nerves. This symptom is usually succeeded in a few weeks, sometimes, indeed, in a few days, by a feeling of pain, which is always in direct ratio to the size of the aneurism, being comparatively slight when it is small, and more or less intense when large. Nor is the pain confined to the site of the disease; in most cases it radiates from it, as from a common centre, in different directions, outwards into the shoulder, downwards along the arm, and upwards into the neck. Pressure, severe coughing, the recumbent posture, and the weight of the limb greatly increase it. Numbness of the shoulder, chest, and arm, is another symptom which generally manifests itself at an early period of the disease, and is never absent when the tumor has acquired considerable magnitude. It is always very distressing to the patient, is greatly aggravated by pressure on the swelling, and commonly extends to the ends of the fingers. Indeed, it is at this point that the sensation in question is often most keenly felt.

The pulsation of the tumor, at first faint and scarcely perceptible, becomes very distinct during the progress of the disease, so that it can not only be felt by the fingers, but seen at a considerable distance; sometimes, indeed, ten or twelve feet from the patient. On applying the ear or stethoscope to the tumor, the blood is found to rush into it with more or less violence, producing a peculiar thrill, or whizzing noise, synchronous with the contraction of the left ventricle of the heart. In the early stage of the disease, the swelling is soft and elastic, and may be readily emptied by pressure; by degrees, however, it becomes firm, tense, and, in great measure, if not entirely, incompressible. In some cases, especially in those attended with great enlargement, there is considerable diminution of the temperature of the affected limb, with indistinctness, if not entire absence, of the pulse at the wrist, more or less cough, dyspnœa, and shortness of breathing. Occasionally the pulse is fully as strong as in the other arm, but irregular or intermittent, losing several strokes in a minute.

In addition to these symptoms, there is always, when the swelling is large, so much displacement of the clavicle as to render it difficult, if not impossible, to distinguish the pulsation of the subclavian artery, the vessel being deeply buried behind and below the bone. In some instances the collar-bone has been found to be considerably imbedded in the tumor, or partially removed by absorption. Another symptom, which, from its frequency, especially in the latter stages of the disease, requires mention here, is the swelling of the affected limb. This varies in degree in different cases, often extends from the shoulder to the ends of the fingers, and is usually of an œdematous character, pitting under pressure, and becoming aggravated by the dependent position of the part. When thus affected, the muscles lose their contractile power, and the motions of the extremity are proportionably impaired, or entirely annihilated. Sometimes, again, owing to the great magnitude of the tumor, the patient is unable to approximate the limb to the side of the chest. Finally, there is another phenomenon, which, as it is almost invariably present in the latter stages of axillary aneurism, I am disposed to regard as pathognomonic. I allude to the peculiar attitude of the patient, arising from the constant inclination of the head towards the affected side, and the manner in which he supports the corresponding arm; the object of both being evidently to prevent the tension which would otherwise be caused in the tumor. Under these circumstances, too, the countenance wears an anxious and distressed appearance, and, as the system sympathizes with the local affection, there is more or less derangement of the general health.

When the tumor is unusually bulky, it will necessarily greatly encroach upon the clavicle, forcing it upwards into the neck, and at the same time exerting severe pressure upon the subclavian artery, perhaps so much as to render it difficult, if not impossible, to distinguish the pulse at the wrist.

Diagnosis.—Notwithstanding that the symptoms of this disease are usually well-marked, it has sometimes happened that tumors of this description have been opened by ignorant practitioners under the belief that they were abscesses. For such stupidity no apology can be offered. Still, cases occasionally present themselves, though very rarely, in which it is extremely difficult, at first sight, to distinguish between this and other swellings in the armpit or subclavicular region. Enlarged lymphatic ganglions, adipose tumors, or encephaloid growths, for example, if they happen to lie along the course of the axillary artery, might have its pulsation imparted to them, and thus create some doubt in regard to their real character. Under such circumstances, the facility with which the tumor can be elevated or removed from the vessel, the absence of the peculiar whizzing sound, previously alluded to, as being generally present in aneurismal disease, the slight pain and numbness in the part and in the corresponding limb, the continuance of the swelling on the application of pressure to the subclavian artery, and, above all, the history of the case, will generally be sufficient to enable the practitioner to arrive at a correct diagnosis.

In this disease the tumor may be situated either immediately below the clavicle, or in the axilla, properly so called. In the former case, it may not only elevate the clavicle, but extend up into the neck, beneath the bone, as far as the acromial margin of the scalene muscles. In the latter, it has been known to reach some distance down the arm, so as to compress the brachial artery and nerves, and prevent the approximation of the limb to the side.

Treatment.—Axillary aneurism occasionally undergoes spontaneous cure, as in the instances reported by S. Cooper and Breschet. Such an occurrence, however, is extremely uncommon. Most generally the disease, if left to itself, terminates fatally, either by rupture of the sac and exhausting hemorrhage, or by gangrene of the limb. In a few rare cases the tumor destroys life by inducing caries of the ribs and perforation of the pleura, followed by a discharge of its contents into the cavity of the chest. In a case narrated by Mr. Guthrie, it was ascertained, on dissection, that the aneurism had forced its way into the right side of the chest by the destruction of a portion of the first five ribs, and had contracted adhesions to the upper lobe of the lung, into which it had gradually opened and discharged its contents, the man having spat blood more or less profusely for several weeks prior to his death. In a similar case mentioned by Dr. Neret, of Nancy, an aneurism, about the size of a large chestnut, was seen to communicate with a cavity as large as the head of a new-born infant in the upper part of the left lung. The man had been admitted into the hospital on account of hemoptysis.

The only remedy for axillary aneurism is ligation of the subclavian artery, and it need hardly be said that the sooner this is done the more likely will it be to effect a cure. The operation, however, should not be declined, even although gangrene of the sac has already commenced, provided there is nothing else to forbid it. I am not aware that aneurism of the axillary artery has ever been cured by compression, nor is this surprising when we reflect upon the difficulty of approaching the subclavian under such circumstances, and also the proximity of the axillary plexus of nerves, which could hardly be induced to brook such an attempt for a sufficient length of time to produce any good effect. If the procedure is ever admissible, it will be in those cases where the tumor is uncommonly small, and the subclavian more than ordinarily superficial. The vessel might then be reached and successfully compressed either by the finger, the handle of a key, or the instrument delineated at page 548, figure 165. If the parts were very tender, the patient might be kept gently under the influence of chloroform while the necessary pressure is maintained, just as the obstetrician occasionally blunts the sensibility of the female for many hours together in protracted and painful labor.

Mortality.—Of 27 cases of axillary aneurism, which I analyzed in 1841 in the Western Journal of Medicine and Surgery, including one of my own, and for which the subclavian artery was tied, 17 recovered and 10 died, death occurring from the third to the thirtieth day, either from hemorrhage, gangrene of the arm, ulceration of the artery, pericarditis, pleurisy, or pneumonia. In one case it seemed to have been caused by effusion into the brain, and in one, my own, it was consequent upon rupture of the aneurismal sac into the thoracic-cavity. In the tables of Dr. Norris, showing the mortality in 69 cases in which the subclavian artery was tied for aneurism, including 9 of wound of the axillary artery and 2 of tumors not aneurismal, though supposed to be so at the time, 36 are stated to have recovered, and 33 to have died.

In three of the cases mentioned in my paper, the subclavian was secured on the tracheal side of the tumor, and all proved fatal. In one of the cases, that of Mr. Colles, the ligature was not tightened till the fourth day after the operation, owing to the supervention of excessive dyspnœa and cardiac oppression.

In my own case, the tumor burst at the end of the twenty-sixth day after the operation, discharging its contents into the right thoracic cavity, and thus causing fatal pleuritis. The patient, a man aged thirty-six years, was suddenly seized with intense pain in the chest, which was particularly severe at the base of the right lung, from which it extended over towards the sternum, on the one hand, and up towards the axilla, on the other. The respiration was hurried, laborious, and fifty-six in the minute; and the pulse, which was quick and tense, rose rapidly to one hundred and forty. Two days after the accident, the patient experienced a sensation near the upper part of the chest, as if a fluid were passing from the pleuritic cavity into that of the aneurismal sac, and, on carefully auscultating the spot, a plashing sound could be distinctly heard at every inspiration, the noise resembling that produced by shaking water in a closed vessel. The respiration in the right lung was now bronchial, and there was extensive dulness on percussion of that side of the chest. It is proper to add that the tumor prior to the operation was about the volume of a large fist, and that had been placed on the artery on the external side of the scalene muscle, came away on the fourteenth day. The dissection revealed the following facts, the arteries having previously been injected.

The wound made in the operation was completely cicatrized, and the pectoral muscles, although somewhat attenuated, retained their natural appearance. The subclavian artery terminated abruptly at the outer margin of the scalene muscle, where the ligature had been applied, its caliber being closed by a mass of solid fibrin, about one-third of an inch in length, which adhered firmly to the lining membrane, and thus afforded an effectual barrier to the passage of the blood. Between this and the thyroid axis the vessel was occupied by a dark coagulum of blood, which, as it was unadherent, was probably formed only a short time before death. Beyond the seat of the ligature the artery had a rough, ragged appearance, and was sufficiently pervious to admit of the ready passage of a small probe into the aneurismal sac. Superiorly the tumor was overlapped by the brachial plexus of nerves, while in front, at its lower part, was the subclavian vein, which, besides being thrown out of its natural course, was considerably diminished in size. No pus was anywhere discoverable, the parts immediately involved in the operation being intimately consolidated by plastic lymph. The aneurismal tumor, placed immediately below the clavicle, was of a conical form, and about the volume of a moderate-sized orange, being two inches and a quarter in diameter at its base. Its walls varied in thickness at different points from half a line to the eighth of an inch, and its interior communicated by means of an oval aperture, one inch and three-quarters in length by an inch and a half in width, with the pleuritic cavity: it was situated between the first and second ribs, nearly equidistant between the sternum and spine, and was obviously the result of ulcerative absorption, induced by the pressure of the tumor. Both ribs were denuded of their periosteum immediately around the opening, and the serous membrane had a shreddy, ragged aspect. The aneurismal sac contained a few reddish clots arranged in a laminated manner, and closely adherent to its inner surface, especially at the part corresponding with the apex of the tumor.

The right thoracic cavity contained nearly three quarts of bloody-looking serum, intermixed with flakes of lymph and laminated clots, the latter of which were of a reddish-brown color, and had evidently been originally lodged in the aneurismal sac. The pleura exhibited everywhere marks of high inflammation, while the right lung was greatly reduced in volume, from the compression of the effused fluid. The left lung was considerably engorged, and at one or two points almost hepatized. The heart and pericardium were sound. The abdominal viscera presented nothing unusual. None of the arteries appeared to have been affected by disease.

There can be no doubt, from the manner in which this case, which was one of a traumatic character, terminated, that the ulcerative absorption which gave rise to the opening above referred to, and which finally led to the escape of a portion of the contents of the aneurismal sac, commenced prior to the deligation of the artery, having been produced by the violent pulsative action of the tumor. Could such an accident have been foreseen, I should not have hesitated to empty the sac to relieve the parts of pressure, objectionable as such a procedure certainly would be in ordinary cases.

An instance of a character similar to the above occurred in 1823, in the practice of Mr. Bullen, of England, and is related in the twentieth volume of the London Medical Repository. The patient was a man, aged thirty-six years, and the aneurism, which was of nearly five months' standing, also occupied the right side. Eighteen days after the operation, the tumor began to increase in size and to become painful. Very soon evidence of suppuration appeared, and at the end of a week, from six to eight ounces of bloody pus were ejected during a violent paroxysm of coughing, the sac immediately diminishing one-half in volume. A puncture being made into the swelling, five ounces of a similar fluid were discharged, to the great relief of the patient. It was now apparent that there was a cavity between the first and second ribs, near their sternal extremities, through which the matter had found its way into the lung, and which now readily admitted air from the latter organ, whenever the man coughed, at which time a little also escaped at the artificial opening. By degrees, the discharge of matter ceased, the cough grew less and less, and at the end of three months the recovery was perfect.

Mr. Erichsen, struck with the extraordinary mortality after ligation of the subclavian artery, in the third part of its course, for spontaneous aneurism in the axilla, determined, if possible, to ascertain the cause of death. For this purpose he analyzed 47 cases of the operation, of which 23 recovered, and 24 were fatal. Of the latter 10 perished from inflammation within the chest, 6 of suppuration of the sac, 3 of hemorrhage, 1 of gangrene of the hand and arm, and 1 of general gangrene, the cause of death in 3 not being mentioned.

The ten cases in the first category died of pneumonia, or of this disease and of inflammation of the pleura and pericardium; produced, as Mr. Erichsen suggests, either by an extension of the inflammation of the deep cellular tissue of the neck to the contents of the chest, by the inward pressure of the aneurismal sac, or, lastly, by the injury inflicted during the operation upon the phrenic nerve.

Suppuration of the sac was the immediate cause of death in six cases, and it occurred also in two of the cases that died of inflammation of the chest. Besides these fatal cases there were six of recovery, making thus an aggregate of 14 cases, or a ratio of nearly one in three. The period at which the suppuration set in varied, on an average, from eight days to four weeks.

Hemorrhage proved fatal in three of the cases, and appears to be a frequent cause of death after suppuration of the sac. It may proceed from the distal orifice of the artery opening into the sac, or from one of the large branches in its immediate vicinity, as the subscapular or posterior circumflex.

Gangrene of the hand and arm was the cause of death in one instance only, although the disease occurred also in two others. In Blizard's case, in which there was sloughing of the sac and pericarditis, the gangrene was confined to two fingers; while in Brodie's case it occurred both in the upper and lower extremities, thus showing that it depended, not upon a want of power in the collateral circulation, as in the other examples, but upon some peculiar state of the constitution.

LIGATION OF THE SUBCLAVIAN ARTERY ON ITS TRACHEAL ASPECT.

This vessel is sometimes ligated on the inner side of the scalene muscles. The subjoined table, comprising ten cases, will serve to place the subject in its true light.

No.	Operator.	Sex.	Age.	Result.	REMARKS.
1	Colles	M.	33	Death	In this case there was only a space of three lines between the sac and the bifurcation of the innominate. The patient died of hemorrhage on the fourth day.
2	Mott	F.	21	Death	The patient died on the eighteenth day of hemorrhage.
3	Hayden	F.	57	Death	The patient died on the twelfth day of hemorrhage.
4	O'Reilly	M.	39	Death	The patient died on the thirteenth day of hemorrhage.
5	Partridge	M.	38	Death	The patient died on the fourth day of pericarditis and pleurisy.
6	Liston	M.	—	Death	Patient died of hemorrhage on the thirteenth day.
7	Liston	M.	32	Death	The patient died on the thirty-sixth day of hemorrhage.
8	Auvert	—	—	Death	Fatal hemorrhage on twenty-second day.
9	Auvert	—	—	Death	Fatal hemorrhage on eleventh day.
10	J. K. Rodgers	M.	42	Death	Fatal hemorrhage on the fifteenth day.

The result in all the above cases, except one, has bee
rhage, notwithstanding the undoubted ability and skil
comprising some of the most illustrious names in surgery
not be sufficient to deter practitioners from repeating
should they continue in their efforts to save life until some
than the rest, shall succeed in finding an exceptional case
late Dr. J. Kearney Rodgers, of New York, in which the
on the left side on account of an aneurism, is full of the
this respect, as showing that, although the patient fi
hemorrhage, yet the ligated vessel was completely clo
coagulum.

Until the operation of Dr. Rodgers, it was universally
ticable to ligate the left subclavian artery on the inside of
such being the intimate relation of the vessel in this situ
the pleura, the carotid artery, internal jugular vein, pn
and thoracic duct. It had been thought that, from the
would necessarily be inflicted upon the surrounding str
operation, violent and fatal inflammation must be the sp
consequence. At all events, no one had yet been found i
devise, and bold enough to execute, such an enterprise.
likely that the operation will soon be repeated, yet the c
serves brief notice here as a matter of surgical history, i

The patient was a man, aged forty-two, who, in conse
heavy weight, upwards of a month previously, suddenly
of aneurism of the left subclavian artery. At the time o
the New York Hospital, the tumor could be seen above
the size of a small hen's egg, extending outwards towar
inwards towards the sterno-cleido-mastoid muscle, by the o
it was considerably overlapped. The signs of aneurism
every particular. The operation was performed on th
1845. Two incisions were made; one, three inches an
along the inner border of the sterno-cleido-mastoid mu
the sternum, and dividing the integuments and platysma-
the other, two inches and a half in length, extending h
inner extremity of the clavicle, the two meeting at a ri
trachea. Several small veins having been ligated, and t
dissected up, the sternal portion with half of the clavic
muscle was divided upon a grooved director, a procedure
into view the sterno-hyoid and omo-hyoid muscles and the
vein, all covered by the cervical fascia. A part of the
also in sight, overlapping a considerable portion of the
the scalene muscle, upon which the operator could distin
nerve. By digging with the handle of the knife and fing
cal fascia was now divided close to the inner edge of
when, after a little search, the subclavian artery was eas
passed over the first rib, pressure upon this portion readi
sation of the tumor. The next step of the operation c
the ligature around the vessel without injury to the pleur
but this proved to be one of extreme difficulty, owing to
ness and depth of the wound, the latter nearly equalling
forefinger. This, however, was at length successfully acc
of an aneurismal needle with a movable point, carried fr
The moment the ligature was tied all pulsation in the tu
patient, if not entirely comfortable, made no complaint o

The wound became somewhat erysipelatous after the o
whole, the patient got on well until the 26th of October,

his position in bed, hemorrhage supervened, and, continuing to recur at various intervals, destroyed him on the fifteenth day. On dissection, the wound was found to be filled with clotted blood, beneath which the artery had been completely divided by the ligature, which lay loose close by. The stump of the subclavian, between the aorta and the point of ligation, was about an inch and a quarter in length, and thoroughly impervious to air and liquids, its caliber being occupied by a solid and firmly adherent coagulum. The distal extremity of the subclavian contained a soft, imperfect clot, while the vertebral artery, which was given off immediately at the site of the ligature, was almost patulous, and had evidently been the seat of the hemorrhage which caused the patient's death. The aneurismal sac, the size of a small orange, was completely blocked up with coagula. The thoracic duct was uninjured, but the pleura at the bottom of the wound was found to be extensively lacerated, and through the opening thus formed a large quantity of blood had passed into the left cavity of the chest.

In reflecting upon this interesting case, Dr. Rodgers regretted that he had not secured the vertebral artery and also the thyroid axis, believing that this would have effectually prevented the fatal hemorrhage.

ANEURISM OF THE BRACHIAL ARTERY AND ITS BRANCHES.

Spontaneous aneurism of the brachial artery and of its terminal branches, the radial and ulnar, is extremely uncommon, for the reason, adverted to in a previous section, that ossification and fatty degeneration of the coats of these vessels are of such great rarity compared with the same lesions of the femoral and its principal divisions. I have, in fact, never witnessed a single example of the disease, and I am not aware that it has ever been noticed by any one in this country. Cases of the disease, however, are mentioned by foreign authorities, among others by Desault, Palletta, Flajani, Pelletan, and Scarpa. Spontaneous aneurism of the ulnar and radial arteries are spoken of by several writers, but in so vague a manner as to render it difficult to determine whether the disease depended upon degeneration of the coats of the vessels, or merely upon laceration by external injury.

All these arteries are subject to traumatic aneurism; the brachial, however, is much more frequently involved than the radial and ulnar, and one of the most common causes of the occurrence is venesection at the bend of the arm, the puncture of the lancet establishing a communication between the vein and the artery, thus giving rise to what is called an arterio-venous aneurism. Or, instead of this, the instrument may almost completely sever the artery, and so induce a diffused aneurism, not opening into the vein, but diffusing its contents, up and down, over a large portion of the inner and fore part of the limb. Some of these latter cases are occasionally very formidable, requiring great judgment and skill for their successful management.

Arterio-venous aneurism may sometimes be cured by systematic compression of the brachial artery, at a distance of five or six inches from the seat of the disease; but in general the most expeditious plan is to lay open the sac, turn out its contents, and tie the artery above and below, the inferior ligature being necessary to prevent hemorrhage from the recurrent branches.

Wound of the brachial artery, without communication with a vein, should be treated, if the case can be reached soon after its occurrence, by compression; but if there be extensive extravasation of blood, constituting what is usually, but improperly, called a diffuse aneurism, the vessel must be exposed at the site of injury, and ligated at its cardiac and distal extremities.

Aneurisms and wounds of the ulnar and radial arteries must be treated upon the same general principles as those of the brachial artery, and do not, therefore, require any special mention. Compression can rarely be rendered available, except at the wrist, and even here it will usually be found to be unsatisfactory, on account of the difficulty of maintaining it in a firm and steady manner. Hence, the proper way is always to ligate the affected vessel at once, not waiting until the parts have become obscured by the extravasated blood. As both arteries are very deep-seated in the upper and middle portions of their extent, rendering it very difficult to expose them, it has been proposed, when they are wounded in these situations, to ligate the brachial; but the objection to this procedure is that, while the cardiac extremity of the affected vessel will thus be closed, the distal one will remain patent, and thus admit of a continuance of the hemorrhage by the recurrent circulation.

Wounds of the arteries of the hand, especially of the palmar arch, are best managed by free incisions and the application of two ligatures. It is great folly, under such circumstances, nay, it is positively worse than folly, to tamper with the comfort and welfare of the patient by the use of compression, either direct or indirect, if the vessel be of any considerable size. Only precious time is wasted; the bleeding will return whenever the mechanical support is taken off, and in this way the patient may lose quarts of blood before the hemorrhage is finally arrested, as I have known to happen in more instances than one. The ligation of the radial and ulnar arteries will be equally unavailing, for blood will still be sent to the wound by the interosseous branch, and, even if this also were secured, still the probability is that the bleeding would go on, especially if some time had elapsed since the occurrence of the accident, owing to the communication of the anastomosing vessels. We now and then read of cases in which the brachial artery has been tied for the arrest of hemorrhage of the palmar arch. Can there be anything more absurd than such a procedure, or that shows a greater degree of ignorance of the anatomy of the hand? The advice of John Bell, in his Principles of Surgery, in regard to the treatment of wounded arteries in general, cannot be too strongly enforced here: "Meet the danger boldly, and don't be afraid to look your enemy in the face."

A curious case of aneurism under the ball of the right thumb has been related by Mr. Pilcher, as having occurred in a goldsmith from the repeated though slight blows inflicted with his hammer in the exercise of his trade. The disease speedily disappeared after ligation of the radial and ulnar arteries at the wrist.

ANEURISM OF THE COMMON ILIAC ARTERY.

The history of aneurism of this vessel remains to be developed. Nothing short, in fact, of a careful analysis of the various recorded cases of it can place it in its true light. That the disease is extremely uncommon in its occurrence is a circumstance which has long been familiar to surgeons. The table of Mr. Crisp supplies only two cases of aneurism of this artery in 551 cases of the lesion as it shows itself in different portions of the arterial system. Both occurred in males. In one, the tumor was seated on the right side; the patient was a sailor, exposed to hard labor in whale-fishing; the aorta was tied by Dr. Murray, of the Cape of Good Hope, but the man died twenty-three hours after the operation. In the other case, the aneurism, also seated on the right side, was of a fusiform shape, and communicated with the common iliac vein. No operation was performed.

The following table exhibits the results of five cases in which the abdominal aorta has been tied for aneurism of the common iliac.

No.	Operator.	Date.	Sex.	Age.	Result.	REMARKS.
1	Cooper	1817	M.	38	Died in 40 hours	The operation was performed for aneurism of the left iliac artery. The tumor being of enormous size, extending four inches above and four inches below Poupart's ligament; the thread was applied three-quarters of an inch above the bifurcation of the aorta. The sac contained an immense quantity of clotted blood.
2	James	1829	M.	44	Died in 3¼ hours	There was an external iliac aneurism, for which the femoral was ligated. Increasing in size, 33 days afterwards the aorta was tied. The ligature was applied eleven lines above the bifurcation of the vessel, and five below the mesenteric artery.
3	Murray	1834	M.	33	Died in 23 hours	There was an extensive aneurism of the right external iliac, the tumor reaching as high as the umbilicus, and more than half way across the lower part of the abdomen. Mortification of the limb was rapidly approaching when the operation was performed. The aorta was tied about four lines above its bifurcation.
4	Monteiro	1842	M.	31	Died in 10 days	A large tumor occupied the lower part of the abdomen and upper part of the thigh. It was a spurious aneurism of the femoral artery, caused by the bursting of that vessel. The patient died, at the expiration of ten days, of secondary hemorrhage, from a small opening in the vessel corresponding with the knot of the ligature, which had been applied four lines above the point of bifurcation.
5	South	1856	M.	28	Died in 43 hours	The aneurism occupied the external and common iliac, and was of immense size. The ligature was applied a little above the bifurcation of the aorta.

It will be perceived from the above table that the five cases in which the abdominal aorta has been tied, all terminated fatally; a result which might assuredly have been foreseen by the distinguished surgeons who performed the operation. Questionable as the propriety of such an operation is, I should, I confess, be strongly tempted to perform it if my patient were placed in circumstances precluding all hope of relief from any other source. That this was the feeling which prompted Sir Astley Cooper, in 1817, to undertake it, and which has since induced others to imitate his example, is more than probable, and our only regret is that their efforts have not been crowned with success. What the effect might have been if the cases had been of a more favorable nature prior to surgical interference is, of course, merely a matter of conjecture, but it is perfectly evident, from their history, that they were all in as desperate a condition as they could well have been at the time. The tumor, in every instance, was of enormous volume, almost, in fact, ready to burst; in Mr. Murray's patient there was, besides, incipient gangrene of the lower extremity. In the case of Mr. James, an error of diagnosis had been committed, which led, improperly, as was afterwards proved, to ligation of the femoral artery, thereby causing the patient not only much suffering but the loss of much valuable time, upwards of four weeks having elapsed between the two operations.

In performing the operation, the peritoneum was divided in two of the cases, and left intact in three; in one instance, it was opened to the extent of nearly four inches. Such a procedure would probably of itself have been a cause of death, had the patient survived the immediate effects of the deligation of the vessel.

The case of Dr. Monteiro, the most successful of all, is replete with interest, as it establishes the fact that the circulation may go on in the lower extremities, after the flow of blood in the abdominal aorta has been completely arrested by the ligature. The patient survived the deligation ten days, when he died of secondary hemorrhage, caused by a small aperture in the side of the vessel corresponding with the knot in the thread. The dissection showed that the peritoneum, which had not been cut in the operation, was perfectly free from inflammation. The aorta had been ligated four lines above its bifurcation, and an inch below the inferior mesenteric artery. The aneurism, which was a false one, had originated in a rupture of the upper extremity of the femoral artery, from which the blood had made its way upwards, underneath Poupart's ligament, through the intermuscular cellular tissue, into the iliac fossa, and thence on behind the peritoneum along the posterior part of the abdomen, as high up as the diaphragm and liver. The common and external iliac arteries were involved in the tumor, and were in an inflamed and friable condition. The external wound had nearly healed.

It is worthy of remark that the pulsation in the tumor ceased immediately on tying the ligature, but returned slightly on the third day, and became more marked on the fourth. Hemorrhage supervened the day before death. The operation was followed by coldness of the lower extremities, but in four hours afterwards this had passed off, and the temperature was now a little above the natural point. No paralysis was present at any time in the limbs.

ANEURISM OF THE INTERNAL ILIAC.

Aneurism of the internal iliac, gluteal, and sciatic arteries is very uncommon, and their history has not been studied with sufficient care to enable us to present anything like a satisfactory account of them. Owing to the deep situation of the former of these vessels, the diagnosis of aneurism occupying its course would necessarily be attended with considerable difficulty, and should not be declared without a good deal of reserve and circumspection. Aneurism of the sciatic and gluteal arteries is more frequently traumatic than spontaneous. In fat, muscular subjects the disease is generally difficult of recognition, and hence it is not surprising that solid growths have sometimes been mistaken for it. Mr. Guthrie once tied the internal iliac artery for a tumor which he had taken to be aneurismal, but which, after death, was found to be of an encephaloid character, the deception having been caused by the circumstance of the tumor having received a distinct impulse from the artery. I have not met with aneurism of the pudic artery, and am not aware that the disease has ever been observed in this country. Mr. Erichsen states that the only instance of the kind with which he is acquainted is exhibited in a preparation in the Museum of the College of Surgeons at London.

Aneurism of the gluteal and sciatic arteries may be treated by ligating the internal iliac, or exposing the sac by a free incision, turning out its contents, and tying the vessel above and below. Such a proceeding would, unquestionably, be very bloody, but by far less hazardous in the end than deligation of the internal iliac.

The *gluteal* artery has been tied at least twice in this country for the cure of aneurism; once by Dr. Davidge, of Baltimore, and once by Dr. George McClellan. The tumors being of great bulk, the incisions were obliged to be unusually large, and the loss of blood was very profuse. Notwithstanding this, however, both patients made an excellent recovery.

ANEURISM OF THE EXTERNAL ILIAC.

Aneurism of the external iliac is a rare affection. In the table of Mr. Crisp, the most elaborate hitherto furnished, it occurs only 9 times in 551 cases, while the femoral is mentioned 66 times, and the popliteal 137 times. In 364 specimens of aneurism contained in the London museums, the same writer found the external iliac affected in 7 cases, the femoral in 12, and the popliteal in 50. The nine cases analyzed by Mr. Crisp all occurred in males:

two, between twenty and thirty; four, between thirty and forty; one, at forty, and one at fifty-six, the age of the other not being given. The disease is most common in hard working persons. One of the worst cases of it that I have ever seen occurred in a priest.

The tumor in this disease may be seated at any part of the artery, but in general it will be found rather low down, and, as it progresses, it manifests a tendency to pass underneath Poupart's ligament into the upper part of the thigh. It usually rapidly augments in size, and is capable of attaining a large bulk, encroaching upon the iliac fossa and the pelvic cavity, lifting up the peritoneum, and pressing forward the structures in the inguino-femoral region, so as to give rise to great deformity in this situation. The pulsation, thrill, and bellows' sound are usually very distinct. If the patient be very thin, compression of the abdominal aorta will arrest the movements of the tumor, and diminish its volume, thus serving to distinguish it from other affections. The diagnosis is, nevertheless, not always so easy as might at first appear. Several cases have been reported where the common iliac artery was ligated on account of morbid growths, supposed to be aneurismal, which afterwards proved to be of a malignant character. On the other hand, a tumor really aneurismal has occasionally been confounded with one altogether of a different character. Such a mistake is most likely to happen when the aneurism is partially solidified by the coagulation of its contents, thereby preventing the perception of pulsation. It is only necessary to allude to the possibility of such an occurrence in order to put the practitioner upon his guard in the investigation of his cases.

When an aneurism of the external iliac artery has attained a considerable bulk, the patient walks with extreme difficulty, and is unable to flex the thigh upon the pelvis. The whole limb is enlarged and œdematous from the obstruction to the return of the venous blood, while the pressure of the tumor upon the femoral nerves keeps up constant pain, with a sense of numbness and stiffness in the parts below, generally extending as far down as the foot and toes.

Aneurism of the external iliac artery, if left to itself, proves fatal in one of three ways, by rupture and hemorrhage, gangrene of the sac or limb, or constitutional irritation. A spontaneous cure now and then occurs, but the circumstance is extremely rare, and, therefore, does not deserve to be taken into the account in our therapeutic considerations.

The only remedy hitherto employed in the *treatment* of this disease was deligation of the artery leading to the tumor; the external iliac, when the aneurism was situated low down, so as to leave a sufficiency of the superior portion of the vessel intact, and therefore in a suitable condition for the reception of the ligature; or, when the reverse was the case, the common iliac, one of the most formidable operations in surgery. I believe, however, that it will be found that the tumor may generally be promptly obliterated, especially in its earlier stages, by compression of the iliac as it passes over the brim of the pelvis; and, although I am not aware that this practice has ever been adopted, yet I am the more inclined to regard it as feasible, from the fact that the external iliac does not give off any branches, in any portion of its course, so as to offer any barrier to the process of solidification of the contents of the sac. The epigastric and circumflex iliac arise just above Poupart's ligament, and could not, therefore, in any wise interfere with the cure. If a case of aneurism of the external iliac should be presented to me, I should certainly give this mode of treatment a fair trial, and should feel very sanguine of success. Digital compression would of course be preferable to any other, on account of the greater facility of its application.

The result of the ligation of the artery leading to and feeding the tumor, has, on the whole, been rather encouraging. In the nine cases mentioned in

Mr. Crisp's table, the common iliac was tied in two, one recovering, and the other perishing of hemorrhage on the eighth day. In four cases the external iliac was ligated, and all got well. In one instance both the femoral artery and the abdominal aorta were tied, but the man died a few hours after the last operation. One case was cured spontaneously, and another recovered under compression.

Within the last few years the treatment of inguinal aneurism by digital compression has been tried. Of four cases thus managed, only one—a patient of Dr. Nichols, of New Orleans—was cured. The thumb was pressed against the neck of the sac for thirty hours, by which time the pulsation had stopped, but, as a matter of precaution, it was continued for ten hours longer.

ANEURISM OF THE FEMORAL ARTERY.

Aneurism of the femoral artery is very common, although less so than that of the popliteal. In Mr. Crisp's cases, 551 in number, 66 relate to the femoral artery, of which 61 occurred in males, thus showing that the disease is very rare in women. The period of life at which it is most frequently met with is from thirty to fifty. As in the other arteries, aneurism of the femoral is most common in the laboring classes, particularly in those persons who are subject to severe muscular exertion of the lower extremities, causing a sudden strain upon the vessel. Instances have been observed in which each femoral artery was simultaneously affected with aneurism, and it occasionally happens that the same vessel has two such tumors connected with it.

The femoral artery is not equally subject to aneurism in all parts of its extent. The superior third suffers more frequently than the rest of the vessel, and external aneurism occurs here much oftener than in any other artery, except the popliteal. Sailors are said to be particularly liable to the disease in this situation, owing, as Mr. Crisp supposes, to the violent flexion and extension of the thigh which they are obliged to make in mounting the rigging and performing other labors on ship-board. I have never seen an instance of spontaneous aneurism in the lower third of the thigh, and general experience concurs in declaring that such an occurrence is extremely uncommon. In some of the published cases, the disease is described as having been femoro-popliteal, a term evidently intended to convey the idea that the lesion involved both the terminal portion of the femoral and the incipient portion of the popliteal.

Diagnosis.—The diagnosis of femoral aneurism, although generally easy, is sometimes involved in so much obscurity as to cause not a little perplexity. This is more especially the case when the tumor is seated along the middle or lower third of the thigh, where the artery is tightly bound down by the muscles and aponeuroses. Abscesses and various morbid growths, solid, semi-solid, or fluid, and malignant and non-malignant, are the affections with which it is most liable to be confounded; and it behooves the surgeon, in every case of doubt, to institute the most careful and thorough examination before he expresses an opinion in regard to its character, or permits himself to engage in any operative procedures for its relief. The best diagnostic, unquestionably, is the effect which compression of the femoral artery exerts upon the tumor, when it is situated some distance below Poupart's ligament, or of the ileo-femoral, when it occupies the superior part of the thigh. If the tumor be aneurismal, the compression will not only arrest its pulsation, thrill, and bellows' sound, but, while it is being kept up, it will enable the surgeon to squeeze out its contents, and thus greatly diminish its volume, circumstances which cannot possibly occur when the swelling is of a non-aneurismal character, whatever may be its structure or consistence. The exploring needle is only to be used in cases not admitting of discrimination by the method here suggested, and then it should be so fine as not to cause hemorrhage or excite inflammation.

The femoral artery, in the upper portion of its extent, is sometimes protruded forward by a *synovial burse*, situated behind the psoas muscle, just below Poupart's ligament, especially when the pouch is inflamed and much distended, in which case it will probably receive an impulse from the vessel, so as to cause the swelling to simulate aneurism. The proper way to determine the diagnosis is to flex the thigh upon the pelvis, a procedure which, by taking off the tension of the muscle, puts a stop to the pulsation of the tumor, and thus reveals the true nature of the disease.

A number of *lymphatic ganglions* lie in the upper part of the thigh, immediately upon and around the femoral artery. Enlargement of these glands has been mistaken for aneurism, and, conversely, aneurism for enlargement of the glands; but the history of the case and a careful examination of the parts will generally promptly clear up the diagnosis.

Psoas abscess occasionally points below Poupart's ligament, and might be mistaken, by a careless observer, for aneurism of this vessel, or of the external iliac. The best diagnostic signs are the want of pulsation, the soft and fluctuating character of the swelling, the absence of discoloration of the skin, and our ability to efface the swelling almost entirely, when the patient lies on his back with the thigh and pelvis a good deal elevated. Moreover, if there is pus, a drop will be sure to follow the withdrawal of the exploring needle.

Progress.—The course of the aneurism is variable. When it is situated high up, it is liable, in its progress, to extend upwards, and to project at length beneath Poupart's ligament into the pelvic cavity. When, on the other hand, it involves the inferior portion of the artery, it may pass down into the ham, and so simulate popliteal aneurism. The swelling usually increases rather rapidly, and, in time, often spreads over a large space, diffusing itself, in fact, widely, in consequence of the giving way of the two inner tunics of the artery. When this is the case, the limb below the seat of the tumor becomes greatly enlarged and œdematous, from obstruction to the return of the venous blood, and the patient constantly complains of stiffness, pain, and numbness in it, extending generally as low down as the feet and toes. In the more advanced stages of the disease, progression becomes difficult and finally impracticable, the whole limb feeling like a dead, heavy mass. A spontaneous cure occasionally occurs; but most commonly the disease goes on from bad to worse, until life is destroyed by gangrene, excessive suppuration, hemorrhage, or constitutional irritation.

Treatment.—The treatment of aneurism of the femoral artery may, I think, generally be successfully conducted by compression, especially now that our means of applying and regulating it are so much better understood than formerly. The compression may be made either with the finger or by means of one of the numerous mechanical contrivances now before the profession. In the case of a negress, aged thirty-two, who was under the joint care of my son and myself, last summer, on account of a large aneurism of the upper third of the femoral artery, the assistants succeeded in effecting complete solidification of the contents of the sac in forty-six hours, by digital compression alone. The tumor progressed most favorably, and in less than three weeks after the operation, the woman was able to walk about the house. In this case, referred to in a previous section, there was not more than an inch of space between the aneurismal sac and Poupart's ligament, in consequence of which the compression was obliged to be applied to the iliac artery as it passed over the brim of the pelvis. Several instances of an equally gratifying termination have followed this treatment in the hands of other surgeons.

When compression is inapplicable, the only resource of course is deligation of the artery which supplies the tumor with blood. The operation is easily done at Scarpa's triangle when the aneurism occupies the middle or lower third of the femoral artery, or even when it extends up to the inferior portion of this space, provided the coats of the vessel are sufficiently sound to bear the pressure of the ligature. When this is not the case, or when the tumor is situated high up, near Poupart's ligament, or projects beneath it partly into the pelvic cavity, the proper remedy will be ligation of the external iliac, an operation which, although not devoid of risk, has now been performed so often and so successfully as to be justly ranked among the established resources of surgery.

Mortality.—In Mr. Crisp's 66 cases, above referred to, the external iliac alone was tied in 43, and in two others both this artery and the femoral; 36 of the patients recovering, and 10 dying. Of the latter, three perished from hemorrhage, four from gangrene of the sac or limb, one from tetanus, one from exhaustion, and one without any apparent cause. In 12 of the cases the femoral artery alone was tied, with a result of 9 cures to 3 deaths. Amputation was successfully employed in five cases; in two, the tumor was obliterated by compression, and in one the disease spontaneously disappeared.

In the table of Dr. Norris, comprising 118 cases of ligation of the external iliac artery, of which, however, 97 only relate to aneurism, 85 recovered, and 33 died, three of the former having undergone amputation of the limb in consequence of gangrene. In 4 of the 97 cases of aneurism, the disease existed simultaneously both in the thigh and in the ham, and in 3 of these the operation succeeded in curing both tumors. A return of pulsation in the sac took place in 9 cases, and hemorrhage in 14, of which 7 proved fatal, and 7 recovered. In 10 cases the tumor suppurated after the operation, although they all ultimately did well. Gangrene of the limb occurred in 16 cases out of the 118, of which 12 died. In two instances the peritoneum was wounded, but both patients recovered.

Finally, a number of cases of femoral aneurism have been recorded in which a cure was effected simply by refrigerant applications to the tumor, aided by steady compression with the bandage, strict recumbency, and an abstemious regimen. This treatment has occasionally succeeded both in the spontaneous and traumatic form of the disease.

ANEURISM OF THE POPLITEAL ARTERY.

The extraordinary frequency of aneurism of the popliteal artery has long been familiar to pathologists and surgeons. With the exception of the thoracic portion of the aorta, there is no artery in the body which is so often the subject of this disease. The table of Mr. Crisp, already so frequently referred to, comprises an analysis of 551 cases of spontaneous aneurism, of which 137 occurred in the vessel under consideration, the thoracic aorta suffering 175 times. Three circumstances seem to serve to establish this extraordinary liability to aneurism on the part of this artery; one is its extreme proneness to ossific and fatty degeneration, another, the curve which it forms behind the knee, and the third, the frequent, sudden, and forcible extension to which it is so constantly exposed in the various movements of the lower extremity.

Age and Sex.—Popliteal aneurism occasionally occurs at a comparatively early age, a number of cases having been observed in which it took place before the twenty-fifth year. Mr. Syme has related one in a child of seven years. The great majority of instances, however, are met with between thirty and fifty. Both sides seem to suffer nearly in an equal degree, and both are occasionally affected simultaneously, or successively, as I have myself witnessed in several individuals. The disease is almost peculiar to men. In Mr. Crisp's cases, 137 in number, 133 occurred in males, and only 4 in females. No occupation is exempt from aneurism of the popliteal artery, but the statistics which have been published upon the subject conclusively show that the laboring classes, especially soldiers, sailors, bargemen, and porters, who are in the constant habit of making long-continued and violent exertions of the muscles of the lower extremities, are more obnoxious to it than any other. The idea, first broached by Morgagni, that postilions and coachmen are particularly prone to popliteal aneurism, has been proved to be erroneous.

Diagnosis.—Aneurism of the popliteal artery is probably produced in most cases by a sudden and violent sprain or twist of this vessel while its coats are in a state of osseous degeneration, and consequently deprived of their elasticity, by which they are prevented from following the various movements of the leg with their accustomed freedom, a sudden rupture being thus induced, of which the patient is himself often made conscious, either by his feeling, or by a kind of snapping noise. The tumor, being at first quite small, generally escapes attention until it has acquired a considerable bulk, as, from the great depth at which the artery is situated, and the unyielding nature of the parts in the ham, it takes some time for it to reach the level of the surrounding surface, or to exhibit to the eye the characters of a distinct swelling. A careful examination, however, will always enable us, even at an early period, to arrive at a satisfactory conclusion respecting the nature of the case, except, perhaps, in very fat subjects. The tumor will be found to throb synchronously with the artery in the groin, and, by grasping it firmly between the thumb and finger, it may readily be pushed about in the hollow between the tendons of the flexor muscles, feeling like an elastic, circumscribed knob, which is easily diminished by pressure, but immediately regains its former size when the pressure is removed. As the disease progresses, the sac increases in volume, and encroaches more and more upon the popliteal space, pushing aside the soft parts, compressing the popliteal vein and nerve, and interfering seriously with the movements of the limb. The leg is habitually bent at an obtuse angle with the thigh, and all efforts to straighten it prove abortive; it is the seat of constant aching pains, with a sense of numbness or tingling; its temperature is notably diminished, and its subcutaneous cellular tissue, owing to the obstruction to the return of the venous blood, is loaded with serum, or serum and lymph, giving the surface a glossy, shining appearance, and causing it to pit under pressure. The ear and the hand readily detect the characteristic thrill and bellows' sound.

Aneurism of the popliteal region is liable to be confounded with other tumors, and we read of cases in which the sac was laid open under the impression that the disease was not arterial. The lesions for which it is most apt to be mistaken are abscesses, solid and fatty growths, and synovial burses.

Abscess of the ham is of very uncommon occurrence, and is in general easily distinguished by the history of the case, its inflammatory character, by the absence of pulsation, by the presence of fluctuation, especially when the matter is considerable in quantity, and by our inability to produce any change in the volume of the swelling by compression of the femoral artery high up in the thigh. When any doubt exists, a small exploring-needle, carefully inserted into the tumor, will readily determine the diagnosis.

Solid growths, of various kinds, benign and malignant, are liable to form in the popliteal region, and might be mistaken for aneurism, especially by a careless and inexperienced surgeon. The fact that such tumors are usually stealthy in their origin, tardy in their development, firm in their consistence, and free from pulsation, will always readily distinguish them from aneurism of the popliteal artery.

A *synovial burse* is occasionally developed in this space, but the occurrence is rare, and it would be difficult to imagine how such a growth as this should ever be confounded with an aneurism in this region. In the Louisville Medical Review, a case of this affection is reported by Dr. S. W. Gross, in which the largest tumor of this description that I have ever seen, occurring in a man, aged twenty-nine years, was readily diagnosticated by the exploring-needle, although its history—especially the absence of pain and pulsation, its non-interference with the patient's occupation, and the preservation of the natural appearance of the leg below the knee—had been sufficiently denotive of its true nature without any expedient of this sort.

Progress.—Aneurism of the popliteal artery may remain circumscribed for a considerable length of time; but, in general, it becomes soon diffused, and by its pressure upon the surrounding structures causes not only great pain and swelling in the leg below the knee, but a tendency to mortification by cutting off the nervous and vascular supplies. Such a termination, in fact, is almost inevitable if the case be permitted to proceed unchecked. Sometimes a spontaneous cure occurs, probably in consequence of the pressure of the tumor upon the artery, thereby arresting the circulation in the sac. Professor Pancoast, some years ago, had a case of popliteal aneurism upon which he had intended to operate the next day; but when he got to his patient's room, he found that all pulsation in the tumor had ceased, and the man gradually recovered without any farther trouble. Occasionally the tumor opens into the knee-joint.

Treatment.—The treatment of popliteal aneurism was, until recently, usually conducted by deligation of the femoral artery in the superior third of the thigh, according to the method of Hunter, first practised in 1785. Since 1840 numerous instances have been cured by compression, and so gratifying has been the result of this procedure that the old operation is likely, before long, to become almost obsolete. In a case recently communicated to me by Professor Blackman, of Cincinnati, that gentleman succeeded in arresting completely the pulsation in a popliteal aneurism by digital compression for two hours, after the failure of various other methods.

Forced flexion, described at page 754, is particularly applicable to aneurism of the ham, and always deserves a fair trial provided the tumor is not so large as to encroach seriously upon the structures of the joint or to threaten to burst into its interior.

Mortality.—The mortality from the operation for popliteal aneurism by the Hunterian method would seem to be variable. In the table of Dr. Norris, comprising a list of 188 cases of aneurism for which the femoral artery was tied, 142 were cured, and 46 died. It is proper, however, to add that the ligation in 33 of the cases was performed for other purposes than aneurism of the popliteal artery. The table of Mr. Crisp furnishes 110 cases, operated upon by the Hunterian method, of which 91 recovered completely, 7 required amputation after the use of the ligature, and 12 died. Of the 11 cases of double popliteal aneurism comprised in it, all were cured; 10 by ligature, and one by compression. The greatest cause of the mortality after the ligation of the femoral artery is gangrene of the leg.

Traumatic aneurism of the ham is unusual. Cases have occurred where it was occasioned by a sabre wound, a musket ball, or the sharp end of a piece of bone in fracture of the femur above the condyles. A few cases are also recorded of arterio-venous aneurism in this situation, in consequence of ulceration establishing an interchange of blood between the popliteal artery and vein.

ANEURISM OF THE ARTERIES OF THE LEG AND FOOT.

Spontaneous aneurism of the arteries of the leg is almost unknown. The traumatic form of the disease, however, is occasionally met with, and there are few cases in surgery more difficult to manage, especially when the lesion involves the posterior tibial artery, owing to the great depth at which this vessel is situated, and the confused condition of the parts in consequence of the extravasated blood. The proper remedy, of course, is free exposure of the affected vessel, removal of the coagula, and ligation of both ends. To accomplish this to the best advantage, often involves great coolness on the part of the operator, and an unusual amount of anatomical knowledge and dexterity. During the operation, the iliac artery should be compressed at the brim of the pelvis, or a tourniquet be applied round the upper part of the thigh. Without such precaution, the hemorrhage might be frightfully profuse.

Injuries of the arteries of the foot are often followed by troublesome hemorrhage, which may eventually become quite exhausting. Cases of this kind are, more than almost any other in surgery, a stumbling-block to men ignorant of surgical anatomy, and it is not going too far to say that they are also, at times, exceedingly perplexing to the educated practitioner, annoying, fretting, and worrying him until his patience is nearly exhausted. The arrangement of the arteries in the sole of the foot is very similar to that of the palm of the hand; the anastomosis between the plantar arteries is very extensive, and hence when these vessels are wounded it often becomes extremely difficult to arrest the flow of blood permanently without the use of the knife and ligature. It might be supposed, at first sight, that well-regulated, systematic compression would put an effectual stop, in most cases, to the hemorrhage, but this, it is well known, is not the fact. It arrests the bleeding temporarily, and that is all. If an occasional exception occurs, it is an exception merely, nothing more. The rule is that the plantar arteries, when divided, will continue to bleed until they are secured by ligature. Why, then, not ligate them at once, without waiting until the patient is blanched and exhausted by the loss of blood, in the vain hope that compression may eventually stop it? That this is the proper course of procedure, is unquestionable; the only objection to it is the extensive wound which we may be obliged to make in order to bring the bleeding vessel fully into view, so as to enable us to apply the ligature. Still, as this must generally be done, sooner or later, in every case, we cannot too strongly insist upon its being done as early as possible after the infliction of the injury. In making the necessary incisions, care must, of course, be taken not to disturb any important structures; and in every instance the golden rule must be observed, to tie each end of the bleeding vessel, lest the hemorrhage should continue through the recurrent branches.

It has been proposed in these cases to cut down upon and tie the principal arteries of the leg, and we read of instances in which even the great trunk of the thigh was ligated for such a purpose. Such a procedure cannot be too strongly condemned, as being contrary both to common sense, anatomical knowledge, and sound experience. The experiment of tying both the tibial arteries has been tried again and again under such circumstances, and the almost invariable effect has been complete failure; as might, indeed, have been anticipated from a careful study of the disposition of the arteries of the foot.

Notwithstanding the somewhat pointed manner in which I have here spoken against compression in hemorrhage of the plantar arteries, it is but proper to add that I have seen this very method occasionally put a most prompt and effectual stop to the flow of blood. I recollect distinctly the case of a little girl, which came under my observation many years ago, where I succeeded, by a single dressing, in arresting an exhausting and daily recurring hemorrhage of upwards of a month's duration. A graduated compress placed over the orifice of the bleeding vessel, and confined by a roller extending from the toes upwards, aided by elevation of the leg and cold applications, constituted, as it always should when such a procedure is adopted, the means employed on the occasion.

Sometimes we may advantageously resort to the expedient of compressing the anterior and posterior tibial arteries by means of two corks, placed directly over the vessels, opposite the malleoli, and bound down firmly by a suitable bandage, passed around the foot and leg in the form of a figure 8. The corks should each be wrapped up in a bit of patent lint, and should be at least three-quarters of an inch in length, and of proportionate thickness and breadth, otherwise it will be difficult to make them retain their proper position. When the compression is obliged to be made with great firmness, it may be well, in order to defend the soft parts, to extend a piece of sheet-lead across the limb under the bandage.

SECT. VIII.—OPERATIONS ON THE ARTERIES.

LIGATION OF THE INNOMINATE OR BRACHIO-CEPHALIC.

Although the innominate may easily be exposed on the dead subject, as was shown by Dr. George McClellan as early as 1820, by a linear incision carried vertically down in front of the trachea, without dividing any of the cervical muscles, yet I believe that such a plan would be ill suited to the purpose when there is a large tumor pressing upon and displacing the parts which environ this vessel. The operator must have ample room, and it will not, I presume, materially affect the issue of the case whether a little more or a little less tissue is cut. The plan suggested by Dr. Mott, in his celebrated case, is, on the whole, it seems to me, the one best adapted for obtaining ready access to this artery, and is that which I should myself follow if I were called upon to secure the innominate for the cure of aneurism. The incision resembles, in outline, the shape of the letter L, the horizontal limb corresponding with the upper border of the clavicle and sternum, and the vertical with the inner margin of the sterno-cleido-mastoid muscle, each being about three inches in length. The lower incision extends as far inwards as the centre of the trachea. The triangular flap thus mapped off, embracing the skin and platysma-myoid, being dissected up, the sterno-cleido-mastoid, sterno-hyoid, and sterno-thyroid muscles are respectively separated upon a director from their inferior connections and turned out of the way. A layer of the deep cervical fascia is now cautiously pinched up and divided, when, by a little scratching with the finger-nail, the handle of the scalpel, or the end of a probe, the carotid will be brought into view a few lines above the top of the sternum, accompanied by the jugular vein and pneumogastric nerve. Taking this vessel as his guide, the surgeon can easily trace the course of the innominate downwards towards the heart, and isolate it from its associate vein. The ligature, when the case admits of it, should be applied about the middle of the vessel, the needle being carried around it from left to right and from behind forwards.

In performing this operation, it should be remembered that this artery is only about sixteen lines in length; that it rests upon the trachea, which it crosses somewhat obliquely at the base of the neck; that the middle thyroid veins, and sometimes the middle thyroid artery, run along its inner side;

and that on the right side, and on a plane anterior to it, is the innominate vein, the two vessels being intimately united together by cellular substance, and in close relation behind with the pneumogastric and phrenic nerves, the latter lying external to the former. The top of the pleura is a little inferior and external to the artery, and might, unless great caution is used, be easily wounded. The middle thyroid artery is sometimes given off by the innominate on its tracheal aspect, and should be looked for in isolating the vessel, as its division might be followed by annoying hemorrhage.

LIGATION OF THE COMMON CAROTID.

To Mr. Abernethy is usually, but erroneously, ascribed the merit of having first tied the common carotid. From some remarks of Hebenstreit, it appears pretty certain that the operation had been performed some time previously by a surgeon during the extirpation of a scirrhous tumor of the neck, in which he accidentally divided this vessel, and immediately surrounded it with a ligature, the patient soon recovering. The English surgeon did not ligate the artery until 1798; the case was one of wound of the internal carotid, and the man died in thirty hours. The first operation that was performed upon it for carotid aneurism was by Sir Astley Cooper, in 1805, and was unsuccessful, the case terminating fatally on the nineteenth day. Three years subsequently, he ligated the vessel again, and now with a happy result.

There are two points of the neck at which the common carotid may be tied, the place of election being regulated by the circumstances of the particular case. These are the upper and inferior cervical regions, and it will be well, in every instance before the operation is begun, to recall to mind the more important anatomical relations of the parts, otherwise serious blunders may arise, such, for example, as tying the omo-hyoid muscle or jugular vein instead of the artery, or including along with the artery the vessel just named, or some important nerve, as the pneumogastric, sympathetic, or laryngeal. As the artery proceeds upwards, it is overlapped by the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and crossed by the omo-hyoid towards its superior extremity. Running down in front of its sheath is the descending branch of the ninth pair of nerves, a little, thread-like filament, easily recognized by its whitish appearance, while within the sheath are, on the external side of the artery, the internal jugular vein, and behind and between them the pneumogastric nerve, the sympathetic and recurrent nerves being posterior to the sheath. These relations are very intimate, and hence the most cautious procedure is necessary in isolating the parts previously to the application of the ligature. The embarrassment is often immensely increased by the manner in which the artery is overlapped by the jugular vein, which occasionally, though less frequently than is generally supposed, swells out enormously during every effort at expiration, so as to obscure the vessel and render its ligation extremely difficult. The best way of remedying this is to request an assistant to compress the vein both at the upper and lower angle of the wound, the blood having been previously pressed out of it.

The common carotid, on the right side, is sometimes absent, its place being supplied by two trunks, which, arising separately from the arch of the aorta, ascend along the neck, assuming the office of the external and internal carotid. When this arrangement exists, which, however, is extremely rare, the order of origin of the branches of the aorta is as follows: the right subclavian, right external carotid, right internal carotid, left common carotid, and left subclavian. It should also be borne in mind that the common carotid may, on the one hand, bifurcate very low down, not perhaps reaching as high up as the inferior border of the thyroid cartilage, and, on the other hand, it may not separate into its terminal divisions until it gets to the angle of the jaw.

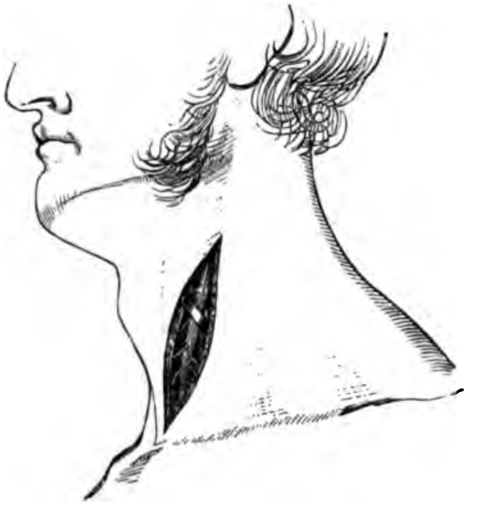
Lastly, it may be crossed in front by the inferior thyroid artery, lie upon the vertebral artery as this vessel passes along the spine, and include in its sheath the descending branch of the ninth pair of nerves.

In ligating the carotid, the patient should be recumbent, with the head inclined to the opposite side, and well supported by pillows, the shoulders being at the same time somewhat raised, in order to place the neck in a proper horizontal position. If he do not desire to take chloroform, he may sit on a chair, the head resting against the breast of an assistant.

In the lower part of the neck the artery may be exposed by making an incision, from two and a half to three inches in length, along the inner border of the sterno-cleido-mastoid muscle, commencing just above the clavicle. The skin and platysma-myoid muscle being divided, a portion of the cervical fascia is pinched up with the forceps, and opened transversely to an extent large enough to admit a grooved director, upon which the membrane is then slit up and down nearly to the length of the outer incision. Two retractors are now inserted into the wound, one being used to draw the sterno-cleido-mastoid muscle outward, and the other to draw the sterno-thyroid inwards towards the trachea. The sheath of the artery being thus exposed, a little piece of it is now raised with the forceps, and divided horizontally, when, the director being introduced, it is slit open so as to denude the artery to a small extent, and enable the operator to isolate it from the jugular vein and the pneumogastric nerve, the ligature being passed from without inwards. Generally a small subcutaneous vein will be found passing along the line of incision, communicating above with the facial vein, and below with the thyroid plexus. This must, of course, be carefully avoided.

The artery being more easy of access in the superior part of the neck than the inferior, this point should always be selected, when this is in our power, for ligating it. To expose the vessel in this situation, an incision should be carried along the inner margin of the sterno-cleido-mastoid muscle, commencing a little below the cricoid cartilage, and reaching nearly as high up as the angle of the jaw. Embracing the integuments, platysma-myoid muscle, and cervical fascia, it will thus conduct the operator at once down to the sheath of the vessel, which is then to be opened in the same cautious manner as in the previous case; and the artery being separated gently from the accompanying structures is ligated by passing the needle round it from without inwards, so as effectually to exclude the jugular vein. The omo-hyoid muscle which crosses this part of the carotid must be held aside with a hook.

Fig. 260.



Ligation of the common carotid.

The annexed cut, fig. 260, represents the common carotid as being exposed by a long incision, with a view of showing where it is crossed by the omohyoid muscle.

When access to the common carotid, in the inferior part of the neck, is rendered difficult on account of the low situation of the tumor, the best plan is to divide the sterno-hyoid and sterno-thyroid muscles, either alone, or jointly with the inner portion of the sterno-mastoid, so as to enlarge the space between the aneurism and the sternum. By observing this precaution, Mr. Porter, of Dublin, was enabled, in one case, to ligate the vessel successfully within the eighth of an inch of the innominate; and examples of a similar character have occurred in the practice of other surgeons.

The carotid is sometimes tied at a very early age. I recollect a case in which I assisted Dr. McClellan, where that excellent and brilliant operator secured this vessel in a child only five months old, on account of an immense nevus of the upper part of the face. I remember, also, that the descending branch of the ninth pair of nerves was divided on the occasion, as it interfered with the passage of the ligature. No untoward symptoms of any kind occurred; the tumor diminished somewhat after the operation, but in less than a month it was larger than ever.

Ligation of the common carotid is occasionally required on account of wounds of the neck involving the external carotid or some of its branches. The operation is often embarrassing in consequence of the confused condition of the parts from the extravasation of blood, and is, moreover, not always successful, owing to the establishment of a return current through the internal carotid into the external carotid. Hence secondary hemorrhage, sometimes of a very profuse character, is liable to ensue, necessitating further proceeding, and that, perhaps, at a time when the wound is in a high state of inflammation. In order to avoid all this, Dr. Gurdon Buck has proposed the simultaneous ligation of the common and internal carotid arteries, and, in the New York Medical Times for November, 1855, he has given the particulars of a case in which the operation was followed by the most gratifying results.

The common carotid artery has been repeatedly secured for wounds, epilepsy, and erectile and other tumors, as well as for the purpose of restraining hemorrhage in operations upon and about the jaw, face, and neck. The statistics of these operations present points of much interest, and they have been placed in a very clear light by the tables of Dr. Norris. In 30 cases in which the artery was tied on account of wounds, 15 recovered, and 15 died; in 16 cases in which it was ligated previously to, or at the time of the extirpation of tumors of the jaw, face, or neck, 8 died; in 6 in which it was tied for the cure of epilepsy, all recovered from the effects of the deligation, although in 2 both vessels were secured; and in 42 cases in which it was tied for the cure of erectile tumors and various growths of the diploë, orbit, neck, jaw, and maxillary sinus, 20 were cured, 13 died, and 9 recovered from the effects of the operation without being materially benefited. In upwards of 20 of the 94 cases, more or less severe cerebral symptoms followed the operation.

Dr. James R. Wood, in 1857, published the details of 39 cases in which the primitive carotid was secured by different surgeons of the city of New York for various affections, as secondary hemorrhage, malignant growths, benign tumors, epilepsy, and aneurism of the branches of the carotid, with a loss of only six. Of these six cases, only five were dissected. The cause of death in two was found to be softening of the brain, in one inflammation of the jugular vein, in one pericarditis with abscess in the lung and liver, and in one exhaustion.

A number of cases have been reported in which both these vessels have been tied, either simultaneously or after a variable interval. The following table affords a summary view of nearly all the examples of this kind that have yet occurred.

Operator.	Date.	Age.	Sex.	Disease.	Interval.	Result.	Remarks.
Macgill	1823	Adult	F.	Tumors of both orbits		Improved	Vision destroyed before operation, and eyes presenting a mass of disease.
Mussey	1827		M.	Anastomotic aneurism of scalp	12 days	Failed	Pulsation returned in tumor, which was excised three weeks after second operation.
Mussey		28		Ditto	28 days	Recovered	
Müller	1831	4½		Erectile tumor	4½ mo.	Recovered	
Preston	1831	51	M.	Epilepsy	84 days	Failed	Fits had existed for six years, and had latterly been attended with palsy on one side.
Preston				Epilepsy	1 mo.	Failed	Convulsions the day after each operation. No material relief.
Kuhl	1834	53	M.	Aneurism of the occiput	72 days		The second operation was performed during a profuse hemorrhage of the scalp. The first operation was followed by syncope and convulsions.
Mott				Disease of parotid	15 min.	Died in 48 hrs.	
Mott				Malignant polypi	Several months	Recovered ?	
Ellis	1844			Secondary hemorrhage	4½ days	Recovered	
J. M. Warren	1845	23		Erectile tumor	33 days	Failed	Tumor occupied the mouth, face, and neck. Subsequent excision of the diseased structures, followed by cure.
Hamilton		18		Epilepsy	6 mo.	Recovered	
Robert			F.	Aneurism	8 mo.	Recovered	
Blackman			M.	Disease of antrum	21 days	Recovered	
W. Parker	1854	42	M.	Malignant disease of nose & orbit	32 days	Died	
G. C. E. Weber	1857	20	M.	Epilepsy	17 days	Improved but not cured	Disease had existed five years; had no attack for seven days after first operation. No cerebral disturbance after either operation.

Of the above cases, 16 in number, 14 recovered from the effects of the operation, and 2 died. In Dr. Mott's case, where both vessels were tied almost simultaneously, coma soon supervened, and the man died in forty-eight hours. In the case of Dr. Ellis, of Michigan, the second deligation was performed at an interval of four days and a half, on account of secondary hemorrhage consequent upon a gunshot wound, and no unpleasant symptoms followed, the patient making an excellent recovery. In Dr. Mussey's case twelve days intervened between the two operations, neither of which was succeeded by any accident. To Dr. Macgill, of Maryland, belongs the credit of being the first to tie both carotid arteries on the same subject.

LIGATION OF THE EXTERNAL CAROTID AND ITS BRANCHES.

The external carotid, extending from the superior border of the thyroid cartilage to the neck of the lower jaw, is situated just above its origin, in the triangular space formed by the omo-hyoid muscle below, the digastric above, and the sterno-mastoid externally, immediately beneath the integuments and platysma-myoid; but it soon sinks deeper in, passing up under cover of the stylo-hyoid and digastric muscles, and is finally buried in the substance of the parotid gland. It is accompanied by two veins, and is crossed near its commencement by the hypoglossal nerve, and, in various parts of its course, by branches of the external jugular and other veins. The glosso-pharyngeal nerve is interposed between this artery and the internal carotid, while the superior laryngeal nerve lies under both.

Deligation of the external carotid is seldom required for anything else than wounds and vascular growths about the face and head. The vessel is often opened in attempts at suicide, though less frequently than is generally imagined; for persons intent upon self-destruction usually bend the neck so far back as to place the artery beyond the reach of the knife. Some of its branches are, however, commonly injured under such circumstances, especially the superior thyroid and lingual, and the hemorrhage thus produced may be promptly fatal. A ligature may be readily placed round the external carotid, in the first part of its course, by carrying an incision, about two inches and a half in length, along the inner edge of the sterno-mastoid muscle, commencing opposite the middle of the thyroid cartilage, and terminating at the angle of the jaw. The trunk of the common carotid will guide the finger to its external division. The incision should be made with great care, lest violence be done to some of the numerous offsets of the vessel. The artery, as it lies beneath the digastric and stylo-hyoid, is exposed with difficulty; the incision must be proportionably large, and the muscles just mentioned must be well depressed with the retractor.

The principal branches of this artery, requiring surgical consideration, are the superior thyroid, lingual, facial, occipital, and temporal.

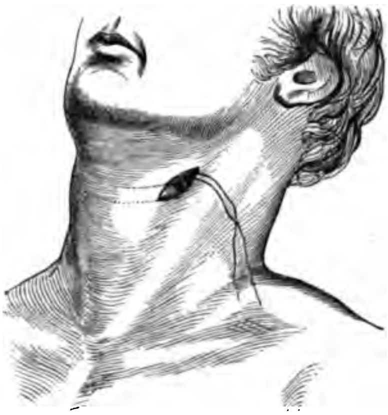
The *superior thyroid artery* is, as already stated, much exposed to injury in attempts at suicide, and may, under such circumstances, be easily traced simply by following the wound. If it becomes necessary to ligate it, as is sometimes the case in hypertrophy of the thyroid gland, with a view to diminish the supply of blood, it may be laid bare by making an incision across the upper part of the neck, obliquely downwards and outwards from the side of the hyoid bone to the edge of the sterno-mastoid muscle.

The *lingual artery* may be exposed in the same manner as the thyroid, near which it takes its origin; its situation, however, is very deep, and its relations are so complicated that it is generally better to secure the external or common carotid.

If the operation should be deemed necessary, it may be performed as follows, according to the plan laid down by Mr. Skey.

"The head of the patient being placed horizontally, and the neck lengthened by raising the chin, an incision of about twelve lines in length should be made immediately behind the corner of this bone, the outline of which should be distinctly ascertained before proceeding to the operation: the incision should be directed downwards and forwards. The skin and platysma being divided, the fascia is exposed, which should be also divided to the length of the external wound. The facial vein, often of considerable size, may be brought into view at the upper part of the wound, in its course downwards to the internal jugular, and should be drawn outwards. The remaining parts should be torn, rather than cut asunder, passing transversely inwards, nearly parallel to the upper edge of the cornu of the os hyoides, when the artery will be exposed. In

Fig. 261.

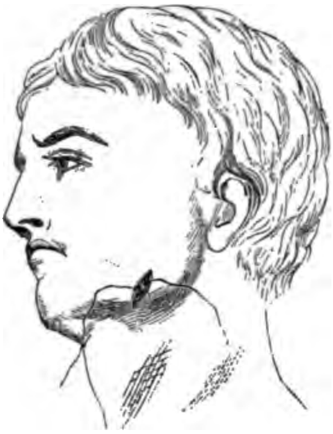


Ligation of the lingual artery.

passing the needle behind it, care must be taken to avoid the superior laryngeal nerve, which descends nearly at right angles behind the artery."

The *facial artery* is frequently concerned in operations about the neck, face, and lips, and may be easily compressed with the finger as it passes over the jaw. If divided, it should immediately be secured. When its ligation becomes necessary, in case there is no wound, its pulsation will point out the proper situation for the incision. When it is desired to secure it just above its origin, the incision should be made as in the operation upon the lingual, its approach being facilitated by drawing the digastric strongly upwards. The vessel is most easily exposed and tied where it lies over the jaw, as in fig. 262.

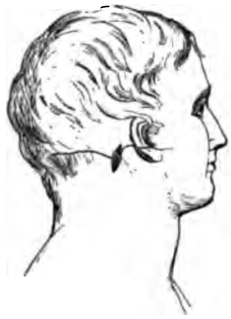
Fig. 262.



Ligation of the facial artery.

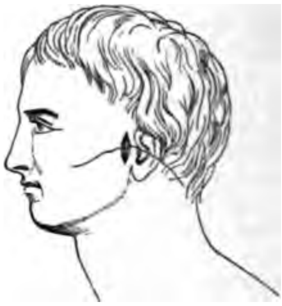
The *occipital artery* sometimes requires ligating on account of wounds, but its depth in the lower part of its extent is such as to protect it generally from injury involving the cervical region. On the back of the head, however, it is not unfrequently laid open, and usually bleeds very freely. It may be exposed just above its origin by carrying an incision along the inner border of the sterno-mastoid muscle, in the angle formed by it and the digastric, the latter of which must be well drawn down. It is in intimate relation here with the hypoglossal nerve, which hooks round it as it passes forwards towards its destination. The artery, after emerging from the splenius muscle, on the back of the head, fig. 263, is superficial, its course beneath the scalp being denoted by its pulsation.

Fig. 263.



Ligation of the occipital artery.

Fig. 264.



Ligation of the temporal artery.

The *temporal artery* is occasionally wounded, and may be secured immediately above the zygoma, by a short vertical incision, fig. 264, embracing the temporal aponeurosis, immediately beneath which it is situated. Lower down, the depth at which it lies is too great to justify an attempt at ligation. Should it be divided in this portion of its extent, the best plan is to tie the external carotid.

The anterior branch of this vessel is the one always selected in arteriotomy, when it is wished to practise depletion on account of affections of the brain or the brain and its membranes. After a sufficient amount of blood has escaped, the artery is cut across, and a graduated compress applied. If this precaution be neglected, a false aneurism will form.

The *internal maxillary artery* is sometimes wounded in consequence of a thrust with a sharp knife or dirk. The necessary result, of course, is a copious hemorrhage, for the arrest of which the only remedy is ligation of the external carotid; compression, it is true, now and then succeeds, but the only reliable means is the ligature. When the vessel is wounded in the extirpation of the jaw, it may sometimes be seized and tied; when this is impracticable, the bleeding may generally be stopped with the hot iron, or with the tampon, wet with a saturated solution of alum and tannin, or covered with persulphate of iron.

LIGATION OF THE VERTEBRAL ARTERY.

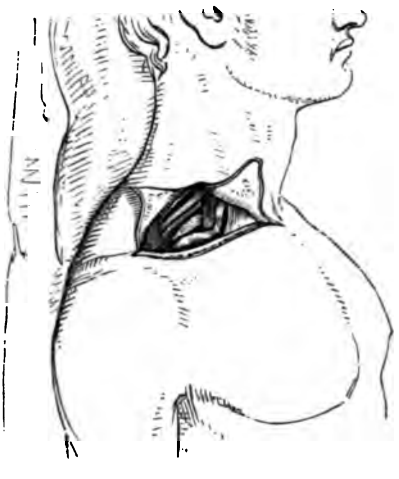
The vertebral artery is the largest branch of the subclavian, and, of course, bleeds profusely when divided, as it occasionally is in wounds of the neck. Taking the opening as the guide, the vessel should be traced to the seat of injury, and a ligature applied to each extremity. The dissection necessary for its exposure should be conducted with the greatest caution, on account of the important and complex relations which the vertebral sustains to the surrounding parts.

LIGATION OF THE SUBCLAVIAN ARTERY.

The point which is usually selected for tying the subclavian artery is just external to the scalene muscle, in what is considered as the third course of the vessel. One single incision will generally be found to be sufficient for the free exposure of the artery, and this may be strictly horizontal or more or less curvilinear, according to the fancy of the operator. It is only when the tumor is so bulky as to cause great malposition of the shoulder, forcing the collar-bone high up into the neck, that two incisions can really be required, the one extending along the upper border of the clavicle and the other vertically upwards, parallel with the outer edge of the sterno-cleido-mastoid muscle.

Previously to commencing the operation, the patient should be placed in the horizontal position upon a narrow table, with his head and chest moderately elevated, and the face slightly inclined towards the sound side. An assistant taking hold of the hand, keeps the affected limb close to the trunk, at the same time that he pulls down the shoulder as much as possible, in order to draw the clavicle away, as it were, from the subclavian artery as it passes from the scalene muscle towards the first rib. The surgeon, standing by the side of the patient, above the shoulder, stretches the integuments of the neck upon the upper part of the chest with the fingers of the left hand, while with the other he makes an incision, about two inches and a half in length, di-

Fig. 265.



Ligation of the subclavian artery, in its outer third.

rectly along the middle of the clavicle, commencing at the sternal origin of the mastoid muscle and terminating near the anterior margin of the trapezius. In this manner he divides the skin, the superficial fascia, and the platysma-myoid. Letting go his hold with his left hand, the parts will be found instantly to resume their natural situation, leaving thus the incision on a level with the superior border of the clavicle. The next step of the operation consists in detaching from this bone the deep cervical fascia, or rather aponeurosis, which may readily be accomplished by a few gentle strokes of the handle of the scalpel instead of the point of the instrument, which would greatly endanger the surrounding vessels and nerves. The external jugular vein will be found close to the outer edge of the mastoid muscle, and should be held out of the way with a blunt hook. The supra-scapular artery will also generally appear, at this stage of the proceeding, just above and behind the clavicle, or partially covered by it, and should be treated in a similar manner; or, if it be divided, it should immediately be tied. The omo-hyoid lies at the outside of the incision, bound down by a process of the cervical aponeurosis, which should next be torn through with the knife. Taking the anterior scalene muscle for his guide, the operator feels for the tubercle of the first rib, a little to the outside of which the artery will be found pulsating, more or less distinctly, and where it may in general be easily secured by passing the needle from before backwards and from below upwards. Before tightening the ligature, it should be ascertained that it controls the circulation of the aneurismal sac, and, above all, that it does not include any of the cords of the axillary plexus of nerves, a circumstance which has happened in several of the cases in which this operation has been performed. It should be stated that whenever the clavicular origin of the mastoid muscle is unusually broad, as it not unfrequently is, it should be divided upon a grooved director. By pursuing this course, I am convinced that our approach to the vessel will, in the majority of cases, be greatly facilitated. Particularly will this be the case when the design is to apply the ligature behind the scalene muscle.

In this manner, the subclavian may, in the generality of cases, be easily reached without much waste of blood or loss of time. In some instances, however, the operation is rendered extremely difficult, tedious, and embarrassing, owing either to the magnitude of the tumor and the consequent elevation of the clavicle, the diseased state of the artery, an unusual course of the vessels of the neck, or, even when these follow their natural direction, the swollen and distended condition of the subclavian vein, some irregularity on the part of the omo-hyoid, an enlarged condition of the cervical lymphatic ganglions, or, finally, the great condensation of the parts from the effusion of plastic lymph. A few remarks on each of these topics must suffice.

1. The *elevation of the clavicle* is generally in direct proportion to the size of the tumor. Sometimes, however, even when the swelling is comparatively diminutive, this bone is situated much higher up than usual, owing to the peculiar conformation of the individual. In either case, the difficulty of finding the vessel will be much increased. In one instance, where the elevation was produced by the enormous development of the disease, Sir Astley Cooper was forced to abandon the operation altogether. When such a contingency arises, which, on the whole, must be extremely rare, instead of giving up the case in despair, as was done by the English surgeon, the best plan, it seems to me, would be to divide the anterior scalene muscle, so as to enable us to apply the ligature somewhat nearer the heart, or even on the tracheal side of that muscle.

2. The operation is occasionally rendered more or less intricate and embarrassing by the *diseased state of the artery*. In this case, although the vessel may be easily enough approached, it is impossible to apply the ligature at

the usual situation. To divide the scalene muscle, or to cut down along its inner margin, for the purpose of securing the vessel at one or other of these points, is here our only resource. The brachial plexus of nerves may also be so much in the way of the operator as to render this course necessary, as happened on one occasion to Dupuytren.

3. The *cervical vessels*, both arterial and venous, are almost constantly in the way of the operator, even when they follow their usual route. This is particularly true of the external jugular vein and of the supra-scapular artery. The former of these vessels, commencing at the angle of the jaw, passes vertically down the neck under cover of the platysma-myoid. In the early stage of its course, it rests upon the sterno-mastoid; afterwards it gets to the outer border of this muscle, and finally, at the inferior part of the neck, sinks behind it, to terminate in the subclavian vein near its junction with the internal jugular. Just before it disembogues, which it sometimes does by several distinct trunks, it receives two pretty large branches, the supra-scapular and transverse cervical, which traverse the neck in a horizontal direction from without inwards, parallel with the arteries of that name. These arteries, as well as their accompanying veins, lie deeply at the root of the neck, especially the supra-scapular, which is frequently concealed for some distance by the clavicle, on a line with which it runs to reach the root of the coracoid process; it is generally a branch of the thyroid axis, and rests at first upon the anterior scalene muscle, crossing as it passes outwards the subclavian artery. The course of the transverse cervical artery is nearly similar, but it is usually situated somewhat higher up; it is also considerably smaller, and is most frequently derived immediately from the subclavian.

Now, in attempting to reach the subclavian, it is almost impossible to avoid wounding some of the vessels above mentioned. The external jugular vein is particularly in danger, and can scarcely escape without the utmost coolness and dexterity on the part of the operator. As soon as it is recognized it should be separated from the surrounding structures by a few gentle strokes with the handle of the scalpel, and drawn to the outer side of the wound. This plan is undoubtedly always the best and safest when it can be adopted; however, it sometimes happens that the vessel is so much in our way as not only greatly to embarrass our progress, but absolutely put a stop to it. In this case, it must be cut across, or, what is preferable, tied with two fine ligatures, and divided between them. By pursuing this method, we not only avoid a troublesome hemorrhage, but effectually prevent the introduction of air into the lower portion of the vessel, an occurrence which should always be guarded against. The supra-scapular artery, if in the way, should be carefully drawn aside, or, if it be wounded, immediately secured. Any bleeding vessels, indeed, no matter whether arterial or venous, provided they pour out a sufficient amount of blood to interfere with the operation, should at once be tied, though no more ligatures should be retained than are absolutely necessary.

4. The inordinate *swelling of the subclavian vein* is another source of embarrassment which is occasionally experienced in operations of this kind. This vessel is usually situated somewhat below and superficially to the artery, being separated from it by the anterior scalene muscle, upon which it lies. Commencing at the inferior margin of the first rib, where it is continuous with the axillary, it passes horizontally inwards until it joins the internal jugular vein, within a few lines of the sterno-clavicular articulation. In this course, in which it is almost entirely concealed by the clavicle, it receives the small branches which accompany the different offsets of the artery as well as the external jugular, which last enters it, as before stated, nearly opposite the centre of the bone, but sometimes more internally. After the division of the cervical aponeurosis in the lower part of the neck, the operator will occa-

sionally observe this vessel alternately to swell and subside, owing not so much, as some have supposed, to the natural flow of the current within it as to the reflux caused by the action of the right auricle, aided by the hurried and agitated state of the respiratory movements. The difficulty thus occasioned is not only annoying, but sometimes so embarrassing as to render it almost impossible even to see the artery, much less to separate and tie it. To remedy this, it has been suggested that the operation should be suspended for a moment, and the patient placed in the semi-erect posture to allow him to make several full and easy inspirations, after which, it is said, the tension of the vein will be diminished, and the regurgitation of the blood cease. The surest and most expeditious plan, however, is to hold the vessel out of the way by means of a broad blunt hook, or copper spatula, carried down behind the clavicle. In this manner the vein may be effectually compressed to the extent of half an inch, or more, if necessary, and the artery fairly brought into view.

5. The *omo-hyoid* muscle, instead of forming a triangular space, as it usually does, with the scalene muscle and the clavicle, may run parallel with, and just above, that bone, or even entirely below it. In either case, should it be productive of inconvenience to the operator, he should pass a director under and divide it. Such a proceeding, however, can seldom be called for, as, by laying open its sheath, the muscle may generally be drawn out of our reach.

6. The *lymphatic ganglions*, at the inferior part of the neck, may be so much enlarged as to interfere seriously with the different stages of the operation. When this is found to be the case, instead of trying to save these bodies, they should be carefully dissected out, as we shall thus not only expedite our arrival at the artery, but, what is a matter of no little importance, greatly facilitate the healing of the parts after the vessel is tied.

7. Finally, considerable embarrassment may arise from the *condensed and indurated* state of the parts, caused by the effusion of plastic lymph. This may always be looked for when the disease is of long standing, or when the tumor is so large as to excite severe inflammation in the deep-seated structures immediately above the clavicle, thereby obscuring the nerves and vessels.

If, from the above causes, it be sometimes difficult to denude the artery, to convey a ligature around it will often be found to be much more so. Indeed, this generally constitutes the most annoying and embarrassing step of the operation. To facilitate this procedure, various mechanical contrivances have been resorted to, some of them so complicated in their character as to be well calculated to enhance instead of diminishing the difficulty. Under ordinary circumstances, every indication may be fulfilled with the common aneurismal-needle, or even with a common eyed-probe. Whatever mechanical contrivance be employed, the ligature, as a general rule, should be passed from before backwards and from below upwards, as it will be found much easier in this way to prevent injury to the subclavian vein, while there will be no danger whatever of including any of the cords of the brachial plexus of nerves. Owing to the great depth of the wound, not a little difficulty is sometimes experienced in tightening the knot. In this case the ingenious instrument invented by Dr. Hosack, of New York, will be found very useful. By holding the first knot firm it enables the surgeon to tie a second or third with the utmost facility.

Notwithstanding the assistance to be derived from the different instruments that have been invented for that purpose, such has been the difficulty, in some instances, of conveying the ligature around the artery as to lead not only to great delay, but almost to an abandonment of the operation. It has been suggested, under these circumstances, to saw through the clavicle, and to this proposal I can see no objection, provided the shoulder is so much elevated as to offer an almost insurmountable barrier to the passage of the ligature. By this practice, although a compound fracture of the clavicle would be superadded, yet this would be of the most simple kind, while the operation, instead of occupying from one to two hours, as has repeatedly happened heretofore, could be completed in a comparatively short time; the vessel could be much more effectually secured, the risk of wounding the subclavian vein and other parts would be greatly diminished, and the patient would have a much better chance for recovery.

The arteries which are more particularly concerned in maintaining the collateral circulation after the ligation of this vessel, are the supra-scapular, transverse cervical, internal mammary, long thoracic, circumflex, and subscapular, the first three being branches of the subclavian, the other three of the axillary. The thoracic artery frequently arises from the aneurismal sac, and is therefore liable to be obliterated for some distance in the progress of the disease.

The subclavian artery has been tied several times in the second course of its extent, but the procedure is very difficult, as well as replete with danger, owing to the proximity of numerous important structures, especially the phrenic nerve, jugular vein, pleura, and thyroid axis. The external incisions are similar to those employed for exposing the artery in the other parts of its extent; as soon as the anterior scalene muscle is fully brought into view, a grooved director is carried behind it, and its lower attachment carefully severed from the clavicle, the phrenic nerve having previously been placed beyond the reach of the knife. The top of the pleura, lying close by, must not be wounded in passing the needle. It will thus be perceived that the operation is one of excessive delicacy, requiring consummate anatomical knowledge and skill for its successful execution. The greatest objection, however, to its performance is that the subclavian is obliged to be tied so close to the superior intercostal and deep cervical branches; a circumstance which must necessarily materially interfere with, if not wholly prevent, the formation of a firm and adherent clot.

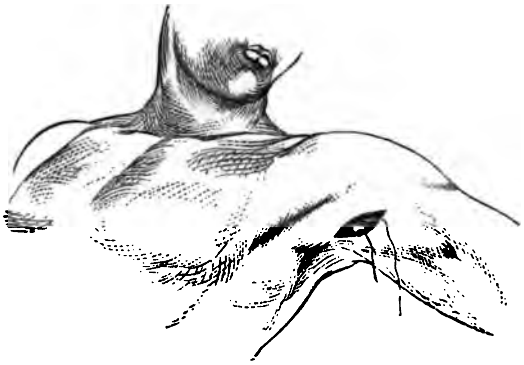
The subclavian is occasionally tied for wounds of the axillary artery. In the table of Dr. Norris, comprising 69 cases of operations upon this vessel, 9 were performed for this purpose, and of these, 6 proved fatal. Mr. Guthrie, in his Treatise on the Diseases and Injuries of the Arteries, refers to 22 cases in which the subclavian was ligated for a similar object, 11 times above the clavicle, and 11 times below. Of the former cases, 9 recovered, and 2 died; death in one being caused by the bursting of an internal aneurism, and in the other, by gangrene after amputation at the shoulder-joint. Of the 11 cases in which the artery was tied below the clavicle, 6 recovered, and 5 perished, three from gangrene of the limb, one from exhaustion, and one from hemorrhage.

LIGATION OF THE AXILLARY.

The axillary artery requires ligation chiefly on account of penetrating wounds, or its accidental laceration during the reduction of ancient dislocations. Of the latter occurrence, quite a number of cases have been reported by surgical writers. There are two regions where the vessel may be secured, either just below the clavicle, or in the hollow of the axilla. In the intermediate point, the vessel is so deeply situated, and in such intricate relations, as to render its approach a task of much difficulty.

The artery in the first of these regions is very deep seated, and hence it has been advised, instead of tying it, to ligate the subclavian in the third stage of its course. Cases, however, occur, in which it is desirable to secure it soon after its origin, and this can generally be done without any difficulty, provided the surgeon is sufficiently cool and deliberate, and has a thorough knowledge of the anatomy of the parts. The patient being placed in a half-sitting posture, with the arm slightly abducted, an incision is carried along the inferior border of the clavicle, through the skin and platysma-myoid, commencing one inch from the sternum, and extending to within a short distance of the deltoid muscle, care being taken to avoid the cephalic vein, as it lies in the groove between the latter and the great pectoral. The next step consists in dividing the fibres of the great pectoral to the full extent of the external wound. The small pectoral is now seen at the lower portion of the wound, and should be relaxed by bringing the arm close to the trunk. A retractor being inserted, and the divided structures well depressed, the artery will be found at a short distance below the clavicle invested by a dense fascia, which must be carefully scraped through before the vessel can be fairly exposed to view. The accompanying vein, which often swells suddenly out during expiration, lies below and in front of it, while the brachial plexus is behind, except one of its branches, which is above and in contact with it. The anterior thoracic artery, one of the offsets of the axillary, is also on its anterior surface. The needle is passed from within outwards, in order to exclude the vein. As difficulty is sometimes experienced in distinguishing the artery from the cords of the axillary plexus of nerves, it will be well, before tightening the thread, to ascertain what effect its application has upon the pulse at the wrist, or in the aneurismal sac. The costo-coracoid ligament sometimes requires division in this operation.

Fig. 266.



Ligation of the axillary, in its inferior division.

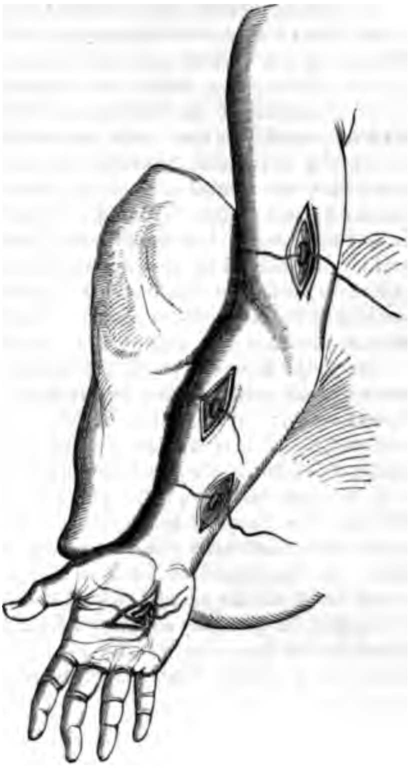
To expose the artery in its inferior section, fig. 266, the arm should be abducted and supinated, and an incision, nearly three inches in length, made through the axilla, close to the border of the broad dorsal muscle. The cellular and aponeurotic structures being next divided, the median nerve and axillary vein will be brought into view, the two roots of the former embracing the artery on each side, and the latter running along its anterior surface. Cautiously separating these parts with the finger, or the forceps and director, and turning them in opposite directions, the artery is exposed, and tied by passing the ligature from within outwards.

LIGATION OF THE BRACHIAL.

The brachial artery, in consequence of wounds and various kinds of traumatic aneurisms, requires to be ligated more frequently than any other artery in the body. Extending from the lower border of the axilla, on a level with the tendon of the teres muscle, to nearly one inch below the bend of the elbow, it is overlapped above by the coraco-brachial muscle, and in the middle by the two-headed flexor, while inferiorly it is completely covered by a reflexion of the brachial aponeurosis. Its whole course, however, is comparatively superficial, so that it is easy to feel its pulsations in the greater portion of its extent. In attempting to secure the artery high up, near its origin, an incision, two inches and a half in length, should be made along the inner margin of the coraco-brachial muscle, the arm being extended and supinated. The artery, accompanied by its two veins, will be found lying here between the median and ulnar nerves, the former being on its outer side, and the latter on the inner. If the artery be sought for at the middle of the arm, the best guide to its seat will be the internal edge of the two-headed flexor muscle. The median nerve, in this part of the course of the artery, usually lies on the inside and in front of the vessel. At the bend of the arm, the brachial is readily exposed by dividing the brachial aponeurosis in a line with the ulnar border of the tendon of the two-headed flexor muscle. In none of these operations is it necessary to divide any muscular fibres.

Schemes for tying the brachial, radial, and ulnar arteries, are depicted in fig. 267.

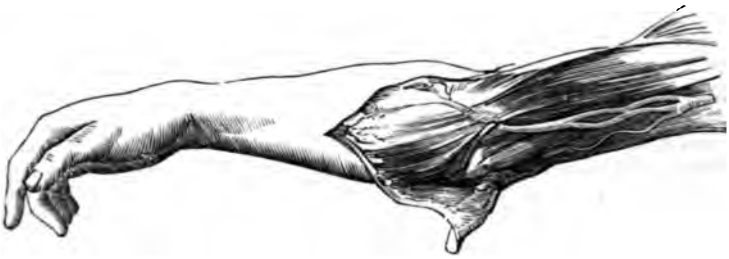
Fig. 267.



Ligation of the brachial, radial, and ulnar arteries; also of the palmar vessels.

In operating upon the brachial artery, it should be borne in mind that this vessel is subject to certain varieties, which may serve both to perplex the surgeon, and mar the result of the undertaking. The most frequent of these anomalies is the high division of the artery into the radial and ulnar, which, on reaching the elbow, either pursue their usual course, or, as is more generally the case, the former proceeds superficially down the forearm, while the latter becomes deep seated; or their course may be reversed, the radial following its ordinary route while the ulnar descends immediately under the skin. Several instances have been met with in which the brachial divided high up into two branches, which subsequently united again into a single trunk, as in fig. 268, which afterwards bifurcated regularly into the radial and ulnar.

Fig. 268.



Double brachial artery.

LIGATION OF THE RADIAL AND ULNAR.

The radial artery, whose course along the forearm is indicated by a line drawn from the middle of the bend of the elbow to the forepart of the styloid process of the radius, may be tied near its origin, at its middle, and at its inferior extremity. When the design is to ligate it above, or in the first of these situations, it may be approached by an incision, about three inches in length, parallel to the inner border of the long supinator muscle, between which and the round pronator the vessel will be found, accompanied by its two veins, the radial branch of the musculo-spiral nerve lying at its outer side and some distance from it. Care is taken not to wound the basilic vein. In the middle third of the forearm, the artery lies between the long supinator and flexor muscle of the carpus, the spiral nerve descending close along its radial border. In the inferior portion of its extent, the artery is comparatively superficial; its pulsation is very distinct in the greater part of its length, and therefore serves as a ready guide to its course.

The ulnar artery is sometimes divided in the upper part of its extent by a knife or ball, and in this event it may generally be easily found by taking the wound as our guide, enlarging it, if necessary, and tying the vessel at each extremity. When a false aneurism exists in this situation, it is usually recommended to ligate the brachial, but I am satisfied that it would be more safe, in every instance, to tie the ulnar soon after its origin, by cutting boldly through the thick muscular mass at the upper third of the forearm, as we could thus effectually guard against hemorrhage from the recurrent circulation. In the middle of the limb the artery lies along the radial border of the ulnar flexor of the carpus, which should therefore be taken as a guide to the knife, and be carefully separated from the common flexor of the fingers. The ulnar nerve here lies on the inner side of the vessel. Near the wrist the artery is generally found with facility, its situation being indicated by its pulsation.

LIGATION OF THE ABDOMINAL AORTA.

Ligation of the abdominal aorta may be required on account of a wound, either of itself or of the common iliac, and in that event the best plan would probably be to enlarge the external opening to an extent sufficient to encircle the vessel with the thread. In ligating the vessel for aneurism, the patient should lie on his right side, and care should be taken to avoid injury to the peritoneum, which can be easily done by adopting the procedure of Dr. Murray, since followed by Monteiro and South, of making a curvilinear incision, with the convexity towards the vertebræ, from an inch above the anterior superior spinous process of the ilium to the cartilage of the tenth rib. It should be fully six inches in length, and should extend, in the first instance, merely through the common integuments. The various underlying structures should then be severally divided until the peritoneum is brought into view, which is cautiously peeled off from the iliac and psoas muscles with the hand a short distance beyond the contemplated point of ligation. The separation of the aorta from its accompanying vein on the right side, and the filaments of the sympathetic nerve in front, constitutes one of the greatest difficulties of the operation, but is generally best effected with a long director, slightly sharp at the extremity, and the nail of the index finger. The ligature should be passed round the artery from left to right, and from behind forwards, about one inch above its bifurcation into the common iliacs.

LIGATION OF THE COMMON ILIAC.

The common iliac artery was first ligated by Dr. William Gibson, of this city, in 1812, in a case of gunshot wound, his patient surviving the operation thirteen days, death being caused by peritoneal inflammation and secondary hemorrhage. Subsequently to this, namely, in 1827, it was tied, for the first time under such circumstances, for aneurism of the external iliac, by Dr. Mott; the ligature came away on the nineteenth day, and in less than two months the man was entirely well, and is, I believe, still living.

This artery has probably been secured altogether nearly forty times. The most extended and reliable statistics of the operation that have yet appeared are those of Dr. Stephen Smith, of New York, who has arranged his cases under four distinct heads, as they relate, first, to the arrest of hemorrhage; secondly, to the cure of aneurism; thirdly, to the starvation of pulsating tumors; and lastly, to the ligation of the vessels, as a means of avoiding hemorrhage during the removal of morbid growths. Two of the tables of Dr. Smith are so interesting and instructive that I shall take the liberty of transcribing them. His paper will be found at length, in the American Journal of the Medical Sciences for July, 1860.

GROUP I.—*Eleven Cases of Ligation for the Arrest of Hemorrhage.*

No.	Operator.	Sex.	Age.	Side.	Disease or accident.	Result.	Date of death.	Cause of death.
1	Gibson	M.	38	L.	Gunshot wound of external iliac artery	Died	15th day	Hemorrhage
2	Liston	M.	8	R.	Hemorrhage after amputation of thigh	Died	24 hours	Exhaustion
3	Garviso	...	...	...	Hemorrhage from bursting of aneurism	Died	4 hours	Exhaustion
4	Pirogoff	M.	...	R.	Hemorrhage after ligature of external iliac	Died	14th day	Hemorrhage
5	Deguise	M.	42	R.	Hemorrhage after ligature of the external iliac	Cured		
6	Post	M.	20	L.	Hemorrhage from an incision into an aneurism	Died	24 hours	Exhaustion
7	Uhde	M.	26	L.	Rupture of internal iliac in applying ligature	Died	4th day	Peritonitis
8	Edwards	M.	27	R.	Rupture of an aneurism of external iliac	Died	25th day	Hemorrhage
9	Holt	M.	24	R.	Hemorrhage from opening a gluteal aneurism	Died	3d day	Exhaustion
10	Parker	M.	20	R.	Hemorrhage from a stab in the groin	Died	10 hours	Exhaustion
11	Buck	M.	40	L.	Hemorrhage after ligature of external iliac	Died	17th day	Hemorrhage

Of the above cases, 10 were fatal, and 1 recovered, being a mortality of nearly 91 per cent. The average period of death was eight days, the cause in 5 being immediate exhaustion, in 4 secondary hemorrhage, and in 1 peritonitis.

GROUP II.—*Fifteen Cases of Ligation for the Cure of Aneurism.*

No.	Operator.	Sex.	Age.	Seat of aneurism.	Result.	Date of death.	Cause of death.
1	Mott	M.	33	Right external iliac	Cured		
2	Crampton	M.	30	Right external iliac	Died	10th day	Hemorrhage
3	Stevens	M.	...	Right external iliac	Died	2d day	
4	Salomon	M.	38	Left external iliac	Cured		
5	Syme	M.	31	Right external iliac	Died	4th day	Gangrene of leg
6	Peace	M.	36	Right external iliac	Cured		
7	Hey	M.	41	Left external iliac	Cured		
8	Garviso	...	...	External iliac	Cured		
9	Lyon	M.	53	Left external iliac	Died	50 hours	Exhaustion
10	Jones	M.	34	Right external iliac	Died	15th day	Erysipelas
11	Wedderburn	M.	25	Left fem., ext. iliac	Died	4th day	Gangrene
12	Van Buren	M.	46	Right external iliac	Died	4th day	Suppuration of sac
13	Stephen Smith	M.	33	Right external iliac	Died	48th day	Hemorrhage
14	Stone	M.	36	Left external iliac	Died	26th day	Dysentery
15	Goldsmith	M.	40	Left external iliac	Died	5th day	Exhaustion

Of the cases comprised in this table, all, except one, were males. The aneurism was located on the right side in 8, and on the left in 6, the seat in one not being given. The mortality was 66⅔ per cent.

In the third group, Dr. Smith gives 4 cases, in which this vessel was tied by Guthrie, Stanley, Moore, and Meier, on account of pulsating tumors supposed to be aneurismal, but which proved to be malignant. All the patients, except one, died.

The fourth group comprises 2 cases, in one of which the artery was tied by Bushe, for an anastomotic aneurism, in a child six weeks old; and in the other by Chassaignac, in a man, aged 49, to prevent hemorrhage. Both patients died.

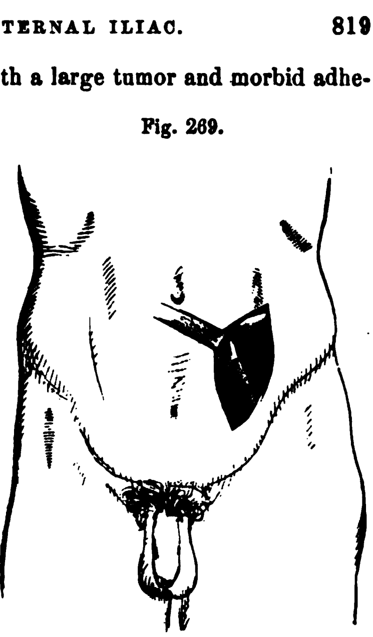
Of the above 32 cases, 27 were males, and 3 females, the sex in 2 not being given. The ages varied from six weeks to fifty-nine years, 22 of the cases occurring between the twentieth and fiftieth years. In 17 cases the right common iliac was tied, and in 13 the left. Of the whole number 25 died and 7 recovered, being a mortality of about 78⅛ per cent. The average period of the separation of the ligature in 12 cases was nearly twenty-three days, the minimum being eight days, and the maximum thirty-six days. In 9 cases the peritoneum was wounded during the operation, and all these, excepting one, died. In 9 cases in which anæsthetics were used, and in 9 in which they were not used, all perished. It would thus seem that the ligation of this artery is one of the most unsuccessful operations in surgery.

The tables of Dr. Smith do not include the case by the late Dr. Luzenberg, of New Orleans, in which the primitive iliac artery was successfully tied in 1846. Dr. Hammond, of San Francisco, also ligated this vessel, but with a fatal issue, in 1861, on account of an aneurism of the gluteal artery, death occurring on the twenty-fourth day.

From numerous trials upon the dead subject, Dr. Smith advises, as the easiest and safest method of approaching the vessel, that an incision be made extending from near the anterior extremity of the eleventh rib to within a very few lines of the internal ring, with a sharp curve inward of one inch. It will thus pass about an inch and a half within the anterior superior spinous process of the ilium, and be about seven inches in length. The curve at the lower extremity of the wound will allow the most perfect freedom in the elevation of the peritoneum, and the complete exposure of the artery.

Ligation of the common iliac, fig. 269, is far from being an easy operation, especially in case of aneurism, attended with a large tumor and morbid adhesions of the peritoneum. The patient lying on his back, with the thighs somewhat relaxed, a slightly curvilinear incision is made along the lower part of the abdomen, about half an inch above Poupart's ligament, commencing at the external ring and passing upwards and outwards a short distance beyond the anterior superior spinous process of the ilium, its length varying from five to seven inches, according to the exigencies of the particular case. The operator should, in every instance, give himself an abundance of room. The first cut extends merely through the skin and superficial fascia. The other structures, beginning with the aponeurosis of the external oblique muscle, are then severally divided upon the director down to the peritoneum, more and more caution being observed in proportion as we approach the deeper parts. The serous membrane is now gently and slowly detached, by means of the finger, from the aneurism and other textures, as high up as the necessities of the case may demand. The artery being thus denuded, is next isolated from the accompanying vein, and the thread deposited by passing the needle from within outwards, above the middle of the vessel. The different steps of the operation will be greatly facilitated if the patient have previously taken an active cathartic, to unload the bowels. Care must be taken not to wound the spermatic cord.

Fig. 269.



Ligation of the common iliac.

The primitive iliac arteries extend from the cartilage between the fourth and fifth vertebræ to the sacro-iliac symphysis, diverging from each other as they descend at a somewhat acute angle, their point of commencement being nearly opposite the umbilicus. Each rests on the spine and psoas muscle, and is crossed anteriorly, at its bifurcation, by the ureter. On the right side, the accompanying vein lies, above, behind and external to it, while, lower down, a portion of the vein appears on the inner side; on the left side, the vein passes along the inner side of the artery, both vessels lying under cover of the sigmoid flexure of the colon. Neither artery presents any anomalies of importance in a surgical point of view.

LIGATION OF THE INTERNAL ILIAC.

The ligation of the internal iliac has now been practised in seven cases, the operation having been first performed by Dr. Stevens, of Santa Cruz, in 1812, upon a negress, on account of a spontaneous aneurism of the gluteal artery, nearly of the volume of a child's head. Of these cases four recovered, and three died, a result which may well create surprise when we take into consideration the great depth at which this vessel is situated, the injury that must necessarily be inflicted upon the surrounding parts in exposing it, and the exceedingly unfavorable character of most of the cases themselves prior to the operation. The artery, moreover, is very short and disproportionably large, being generally less than two inches in length; it is, besides, in intimate relation with various important structures, thus rendering it extremely difficult of access. Thus, it lies on the internal iliac vein, which, however, on the right side projects from underneath it over its outer edge; it is crossed above by the ureter, and is overhung by the bladder, while that on the left side lies immediately behind the rectum. Close by are the sacro-lumbar and obturator nerves, the latter, along with the external iliac vein, running in the angle which separates the internal from the external iliac artery.

The manner of exposing the artery is the same as in ligating the common iliac. Dr. White, of Hudson, who tied this vessel successfully in 1827, for gluteal aneurism, made a semi-circular incision on the side of the abdomen, with its convexity to the ilium, seven inches in length, commencing two inches to the left of the umbilicus, and terminating close to the external ring. It is not necessary, however, I conceive, to carry the incision so far inwards, as the object can be just as well attained by the other process, and with less risk of bad consequences. The peritoneum is carefully raised with the fingers; and it is worthy of notice that the membrane, as it is being peeled off, invariably carries with it the ureter, thus placing this duct completely beyond the reach of the ligature. The fascia investing the artery is scraped away with the nail or handle of the scalpel, and, taking the precaution of avoiding the external iliac vein, which lies in the angle between the internal and external iliac arteries, the ligature is deposited by passing the needle from within outwards.

When the internal iliac artery is very short, or the pelvis unusually small, so as to render the ligation of the vessel very difficult, it would be more prudent to secure the common trunk; the procedure would be attended with less violence to the parts, and with less risk of peritonitis and secondary hemorrhage.

LIGATION OF THE GLUTEAL.

The gluteal artery has been repeatedly ligated on account of hemorrhage and traumatic aneurism, as, for example, in the famous case of Mr. John Bell, where, to use his own hyperbolical language, the incision was upwards of a foot and a half in length. In exposing the vessel for the relief of hemorrhage, the surgeon is necessarily obliged to take the external wound as his guide, enlarging it, if possible, in the direction of the muscular fibres, and giving himself an abundance of room, especially if the artery be divided just as it emerges from the sacro-sciatic notch. It must be remembered that the vessel is accompanied by a vein and nerve, which must be carefully excluded from the ligature. If the artery be cut off close, it may be necessary to pass the thread with a curved needle, and to include in the noose some of the surrounding tissues, as it will probably be impracticable to raise it with the tenaculum.

In case of traumatic aneurism of this artery, most writers recommend the ligation of the internal iliac; but, when we remember the difficulties and dangers of this operation, and the probable occurrence of peritoneal inflammation and of secondary hemorrhage, it seems to me that it would be better, in every respect, to cut down upon and tie the gluteal itself. The operation will of course be bloody and formidable, but skill, boldness, and promptness may accomplish much, even in a case like this, especially when everything is well ordered beforehand, and the assistants are properly instructed in their respective duties. The incision, made in the direction of a line extending from the posterior superior spinous process of the ilium to a point midway between the tuberosity of the ischium and the great trochanter, must be at least eight inches in length, and should be carried at one stroke down into the aneurismal sac, the contents of which should then be turned out, and the artery instantly secured, as it lies towards the upper part of the wound.

LIGATION OF THE SCIATIC ARTERY.

The sciatic artery is also liable to be injured, either by sharp-pointed bodies penetrating the gluteal region, or by falls upon the buttock in which the vessel is laid open by a splinter of bone round which it passes as it proceeds forwards. It is situated under the great gluteal muscle, at first posterior and then internal to the great sciatic nerve, and winds round the spinous process of the ischium, near its root, behind the muscles which are inserted into the intertrochanteric line of the femur. It may be exposed by making a similar incision, as in the preceding case, but about an inch and a quarter lower down. When the operator is in doubt as to which artery is implicated, whether the sciatic or gluteal, the incision should be made as nearly as possible in the intermediate space.

The sciatic artery has been tied, in at least one instance, for an aneurism seated upon its own trunk, Dr. Dugas, of Georgia, being the operator. Owing, however, to secondary hemorrhage, caused, apparently, by the patient's own imprudence, the common iliac had to be secured at the end of a week, when the man was almost moribund from the loss of blood. Death occurred four days afterwards.

LIGATION OF THE EXTERNAL ILIAC.

Ligation of the external iliac artery was first practised by Mr. Abernethy, in 1796, in a case of aneurism of the femoral artery, which he had previously tied at the distal side of the tumor; but severe hemorrhage coming on some time after, he found it necessary to apply a ligature above the swelling. The operation, however, failed; and it was not until 1806, after two other attempts, that his efforts were finally crowned with success. In this country it was first performed by Dr. Dorsey, of this city, in 1811, in a case of inguinal aneurism.

There are several methods in vogue for exposing this artery and encircling it with a ligature, each of which has its advantages and disadvantages, although the results have perhaps not essentially varied in any. That of Abernethy, slightly modified, is perhaps the most unexceptionable. It consists in making a curvilinear incision, with the convexity downwards, along the inferior portion of the abdomen, commencing about an inch and a half above Poupart's ligament, just outside of the external ring, and terminating on a level with the anterior superior spine of the ilium, about two inches on the inner side of this process. Its length should be from three inches and a half to four inches, according to the size of the tumor, and the stature of the patient. The first cut, extending through the skin and superficial fascia, will probably divide a few little arteries that should be tied before proceeding any farther. The aponeurosis of the external oblique muscle is now in sight, and should be divided upon the director; then the muscle itself; and afterwards each, in regular succession, of the overlying structures, until the transverse fascia is exposed. This membrane will readily be recognized by its opaque, whitish appearance; and a small hole being scratched through it with the nail or scalpel, is next slit open to the full extent of the outer wound. The next step, and one of the most delicate of all, consists in gently and cautiously detaching the peritoneum from its connections in the iliac fossa; an operation which is often attended with considerable difficulty on account of the morbid adhesions. The iliac artery will now be felt pulsating at the bottom of the wound, having the anterior crural nerve at its outer side, and on a somewhat deeper plane, and the iliac vein at first behind, but afterwards, near Poupart's ligament, internal to it. The sheath covering the artery

being now scratched through in front over a sound porti
instrument bearing the ligature is gradually insinuated
inner side, this procedure being found best to avoid inju

There are several circumstances worthy of attention in
ligation of the external iliac. In the first place, the lig
sible, be placed round the vessel about its middle, whic
inches above Poupart's ligament, the artery being usua
and a half to four inches in length. If the ligature be
near to the origin of the epigastric artery, there may no
for the formation of a coagulum, and the patient may
hemorrhage, as happened in one case to Béclard.

Secondly, care must be taken not to wound the perit
nessed several instances in which it was separated with i
consequence of the great firmness with which it adhere
sac, from the effects of plastic deposits. In a case wh
practice of Dr. Post, of New York, the membrane was
and altered by disease that he found it quite impossible
obliged to make an opening into it in order to admit his

Thirdly, no little difficulty is occasionally experience
artery from its accompanying vein, owing to their natura
is no doubt often increased by disease. The object is
with the nail or a probe, slightly sharpened at the extre

Fourthly, should the external iliac be found to be to
the tumor so large as to overlap the greater portion of
do when the sac extends upwards beneath Poupart's liga
to ligate the common trunk simply by enlarging the wo
upper angle.

Fifthly, the operation will be greatly facilitated if the
bowels be well evacuated a short time previously.

Lastly, the wound made in the operation should in th
of the other pelvic arteries, be sewed up carefully from t
ing the needle close down to the peritoneum; in other
and integumental lips should be tacked together separat
the production of firm union, so that there may be no ris
patient begins to sit up and walk about.

After the ligation of the external iliac, the collateral
tained chiefly by the anastomosing branches of the glute
and pudic arteries, with the circumflex and deep branche

LIGATION OF THE EPIGASTRIC AND CIRCUMFLEX

The *epigastric artery* is occasionally wounded, eithe
operating for hernia, tapping the abdomen, or ligating th
although small, may give rise to fatal hemorrhage, the
bleeding is generally insidious and deep seated, and it
secured without delay. To do this, an incision, about t
is made just above, and parallel to, Poupart's ligament, i
ing with its centre, cautiously dividing the parts until t
as it lies between the transverse fascia and peritoneum.
by two veins, which must be carefully excluded from
artery arises on the inner side of the external iliac, abo
Poupart's ligament, and ascends inwards just within the
internal ring, where the deferent duct hooks round it on
minal canal. Should the vessel be cut off close to the ex
become necessary to cast the thread around this artery
gastric.

The *circumflex iliac* artery, given off by the external iliac, usually a little lower than the epigastric, is sometimes wounded, and may, from its large size, cause embarrassing, if not fatal, hemorrhage. It may be secured, in the first part of its course, in the same manner, very nearly, as the epigastric, the incision being made close to, and parallel with, Poupart's ligament, its centre being opposite the internal ring. Further out, it may be exposed by dividing the tendon of the external oblique muscle within half an inch of the margin of the ilium, where it is firmly bound down by the transverse fascia.

LIGATION OF THE FEMORAL.

The common femoral artery begins on a level with Poupart's ligament, and terminates from an inch and a half to two inches below in the superficial and deep femoral, the former being its direct continuation. The vessel, in all this course, is perfectly superficial, being covered merely by the skin, superficial fascia, and aponeurosis; it is involved, however, in a number of lymphatic ganglions, which, when they become enlarged, may receive the pulsation of the artery, and so simulate aneurism. The femoral vein lies on the inside of the vessel, in the same sheath, and great care is required in separating it previously to passing the ligature. The femoral nerve lies external to the artery, and is therefore not endangered in the operation. Exposure of the artery is easily effected by a vertical incision two inches in length; the needle should be conveyed from within outwards.

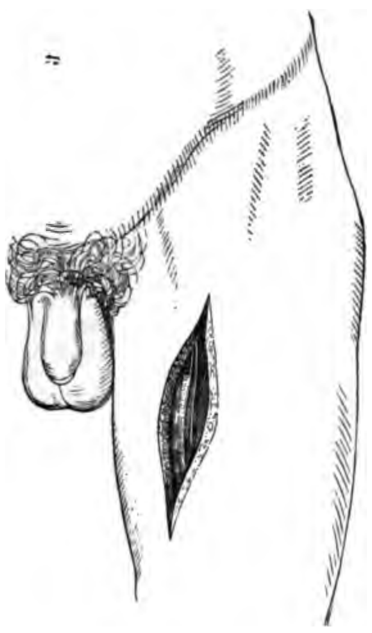
Ligation of the superficial femoral artery is often necessary on account of wounds involving its continuity, and, until a comparatively recent period, it was also frequently practised for the cure of popliteal aneurism. If the artery be severed by a cut, or pierced by a sharp-pointed body, it is evident that it should be secured at the site of injury, the wound being, if necessary, enlarged, and a ligature applied to each extremity of the vessel.

In case of aneurism, the femoral artery may be tied at two points of its extent, namely, at the superior and middle, the former being, however, by far the more eligible, as the vessel here is comparatively superficial, and therefore easy of access. Its course along the thigh is indicated by a line extending from a quarter of an inch within the centre of Poupart's ligament to the inner margin of the patella. In the upper third of the limb, it lies immediately beneath the common integuments and the femoral aponeurosis, its pulsation being easily felt as it runs along the inner margin of the sartorius muscle. This space is from four to five inches in length, and is of a triangular shape, its base being formed by Poupart's ligament above, and its apex by the convergence of the sartorius and adductor muscles below. The femoral vein runs along the inner border of the artery, and is inclosed in the same sheath; the connection between them is very firm and intimate, and it therefore requires great caution to effect their separation. The femoral nerve lies on the outside of the artery.

To expose the artery in this part of its course, an incision should be made along the inner border of the sartorius muscle, beginning about two inches and a half below Poupart's ligament, and extending obliquely downwards to the lower extremity of the triangle through the skin and superficial fascia. A portion of the aponeurosis is now pinched up with the forceps, and a horizontal opening made in it just large enough to admit the point of the probe, upon which the sheath of the vessel is then carefully divided for the space of about nine lines. The artery is now separated from the vein in the usual manner, but with extreme caution, and the ligature passed from within outwards, close to the former vessel. Injury to the vein would be a serious calamity, as the patient might perish from phlebitis. The occurrence is usually denoted by a gush of black blood upon drawing out the thread. Pressure will readily arrest the flow, and the vessel must on no account be tied. A little nerve occasionally runs down in front of the artery; should this be the case, it must be drawn out of the way.

The femoral artery, in its middle course, as seen in fig. 270, is deep seated, lying under cover of the sartorius muscle, which must, consequently, be turned to one side in the act of exposing it. The corresponding vein will be found external to the artery. In some instances it is double, and then the artery runs between the two vessels, closely hugged by them. In operating upon the superior portion of this space, just below the triangle above described, the incision should be made along the inner edge of the sartorius, which is then everted so as to afford free access to the vessel as it lies beneath the aponeurosis. If, on the other hand, the lower site be selected, the cut should be made on the outside of the muscle; but no one will be likely to do this if he can avoid it, as the operation will be both tedious and difficult, and possesses no advantages whatever over the more common procedure.

Fig. 270.



Ligation of the femoral artery in its middle course.

The femoral artery is subject to certain anomalies which should not be forgotten when we undertake its ligation, as they might seriously affect the result. The most important of these anomalies are the following: First, the high division of the artery, the vessel separating a short distance below Poupart's ligament into two branches, which go to form the posterior tibial and peroneal. Secondly, the artery may be double, the supernumerary one giving off the branches usually furnished by the profunda. Thirdly, it may consist of two equal trunks which afterwards unite to form the popliteal. Sir Charles Bell found this curious anomaly in a negro upon whom he operated for popliteal aneurism, the two vessels coalescing as they entered the ham. In this case the blood in the sac had in a great measure coagulated, notwithstanding that the circulation through it had been maintained by the artery, which had not been excluded from the ligature. A similar instance occurred to Sir Astley Cooper. An abscess formed in the sac, after the detachment of the ligature, and the patient died of hemorrhage. The dissection showed that a large branch had been given off by the femoral artery above the point of ligation, and had again united with that vessel just before it terminated in the popliteal, thereby feeding the tumor, and preventing its obliteration. A case of the entire absence of the superficial femoral artery has been recorded by Manec, its place having been supplied by the sciatic which passed down along the back of the limb to become the popliteal.

Compression of the femoral artery is often necessary on account of hemorrhage, either of this vessel itself, or of some of its branches. It is also frequently employed for the purpose of controlling the circulation of the limb in amputations of the thigh and leg; and latterly, it has been much resorted to for the cure of popliteal aneurism, having, in many cases, superseded the use of the ligature. When the object is to arrest the flow of blood, or stanch hemorrhage, the most suitable point for its application is the margin of the pubic bone, which is separated from the artery only by the pectineal muscle, and upon which, consequently, the pressure may be made with great efficiency. The best instrument for the purpose is the thumb of a stout assistant, or the handle of a large key, resting upon a small, thick pad. The more concentrated the pressure is, the more efficacious it will be in stopping the bleeding, and in preventing injury to the accompanying vein and nerves, circumstances that must not be overlooked in such a procedure. If the force be applied with the thumb, it may often be maintained for several successive days without detriment to the parts.

The other situations at which the artery may be compressed are the upper part of the thigh, just below Poupart's ligament, and those portions of the limb where the vessel may be pressed against the shaft of the femur, by directing the instrument outwards and backwards. When the compression is designed to be permanent, as in the treatment of popliteal aneurism, it should be frequently varied, making it now at this point, and then at that, as it may be painful or otherwise; and it is, moreover, of great importance, under these circumstances, that the instrument with which it is applied should not completely encircle the extremity, lest it impede the return of the blood in the veins, and thus occasion swelling and other mischief.

LIGATION OF THE DEEP FEMORAL.

The deep femoral artery has been known to be the seat of spontaneous aneurism, but the occurrence is extremely rare, and very difficult of diagnosis. The profound situation of the tumor, underneath the muscles at the anterior and inner part of the thigh, will usually serve to throw some light upon its character; but the only reliable sign is the continuance of pulsation, thrill, and bellows' sound, with somewhat of an augmented intensity, in the swelling, when firm pressure is made upon the superficial femoral, about two inches below Poupart's ligament, so as to direct the blood with increased force into the deep vessel. The proper remedy, in such a case, as well as in traumatic aneurism, would be ligation either of the affected artery, or of the common femoral, an inch below its origin, where it is felt beating immediately beneath the skin and aponeurosis. The application of the ligature to this vessel is sometimes required on account of hemorrhage.

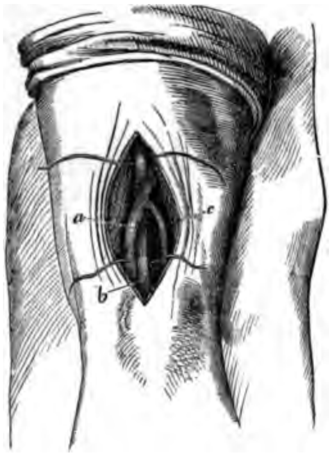
The deep femoral is usually given off by the common femoral, from an inch and a half to two inches below Poupart's ligament; but it is sometimes detached considerably higher up, and occasionally it is furnished by the external iliac or by the femoral, immediately after the commencement of this vessel. The artery, soon after its origin, passes inwards, behind the superficial trunk, and gradually places itself under cover of the long adductor muscle, between which and the great adductor it afterwards descends towards the femur, near which it pierces the latter muscle, and finally disappears on the posterior part of the thigh. When this vessel is injured, the wound will, of course, serve as our readiest guide to it; and in that event, two ligatures will always be necessary to put an effectual stop to the hemorrhage. In case of aneurism, the artery may easily be exposed, near its origin, by an incision similar to that which is made in ligating the common femoral, or the superficial femoral, in the superior portion of its extent, beginning an inch below Poupart's ligament, and descending obliquely in the direction of the inner border of the sartorius muscle. The deep trunk may then be readily traced to the requisite extent, and should be encircled a few lines below the origin of its two circumflex branches.

LIGATION OF THE POPLITEAL.

The popliteal artery being situated deeply in the cavity of the ham, in close relation with numerous important structures, is very difficult of access, especially in fat subjects. Fortunately it is seldom necessary to attempt its deligation, as wounds and traumatic aneurism here are of extremely infrequent occurrence. The artery is in intimate connection by its outer and posterior surface with the popliteal vein, from which it is not always easily detached. Sometimes the vein is double, and then the artery lies between the two trunks, closely and firmly embraced by them. The popliteal nerve is separated from the vessels by a thick layer of fat; superiorly it lies exterior to the artery, but as it descends towards the leg it gradually winds round it to place itself along its internal border.

There are two points at which the popliteal artery may, if necessary, be exposed for the application of the ligature; these are its superior third and its inferior third. The middle portion of the artery is never interfered with, on account of its great depth, its near proximity to the knee-joint, the unyielding character of its lateral boundaries, and its intimate connection with the accompanying vein and nerve.

Fig. 271.



Ligation of the popliteal at its upper and lower parts. *a.* The popliteal vein. *b.* The popliteal artery. *c.* The posterior saphenous vein. The popliteal nerve, on the outside of the artery, has been accidentally omitted in the diagram.

The artery may be ligated in the upper third of its extent, where it is more accessible than anywhere else, by carrying a vertical incision along the outer border of the semi-membranous muscle, for about three inches, extending down as far as the popliteal nerve. The muscle is then drawn inwards and the nerve outwards, when, by the cautious use of the forceps and handle of the knife, the vein and artery will be easily found, and must be gently and carefully separated from each other, the needle being passed from without inwards.

Exposure of the artery, in the lower third of its extent, may be effected by a vertical incision between the heads of the gastrocnemius muscle. Care is taken not to injure the posterior saphenous vein and nerve, which lie close by, but to draw them, along with the popliteal nerve, away from the knife. The artery will be found to be deeply imbedded in the ham, partially concealed by the popliteal vein, but projecting somewhat to its outer side.

In our attempts to expose the popliteal artery, care must be taken not to make too free a use of the knife, for fear of wounding the articular branches which are given off at a right angle, and which might, if injured, cause embarrassing hemorrhage.

LIGATION OF THE ANTERIOR TIBIAL.

The anterior tibial artery may require to be tied on account of hemorrhage or traumatic aneurism, and the best plan always is to take the external wound as our guide to the seat of the injury. The vessel, whose course is indicated by a line drawn from the head of the fibula to the base of the great toe, may be secured at three different points.

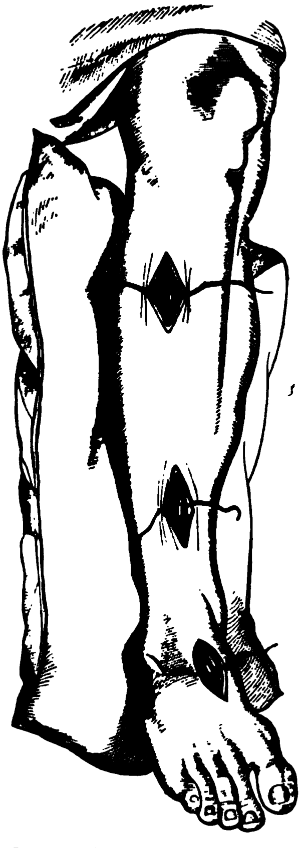
The artery, in the superior third of its extent, lies underneath and between the anterior tibial and common extensor muscles, and may be exposed by a vertical incision, four inches in length, carried down in the direction of the line just mentioned. The skin and superficial fascia being divided, the aponeurosis is to be slit open upon a director to the full extent of the outer wound; the two muscles are then to be separated from each other along their raphe, and the artery, which lies in close contact with the interosseous ligament, is surrounded with the ligature, care being taken not to injure the accompanying veins. The anterior tibial nerve is exterior to the vessels.

In the middle third of the leg, the relations of the vessel are essentially the same as in the upper, except that the long extensor of the toe is interposed between the anterior tibial and common extensor. The artery is still deep-seated, and a long incision is required for its full exposure. A branch of the peroneal nerve sometimes attaches itself to the artery here, and must be drawn away before passing the ligature.

In the inferior third of the limb, the artery lies on the tibia, between the tendons of the common extensor of the foot and the proper extensor of the great toe, the latter overlapping it on the inside. The vessel here is, therefore, comparatively easy of access.

The *dorsal artery* of the foot, the continuation of the anterior tibial, may be easily tied in any portion of its extent, as it runs down across the instep, its course being indicated by a line extending from the centre of the ankle-joint to the posterior extremity of the first interosseous space. It lies under cover of the integuments and aponeurosis, and may readily be exposed by carrying the knife along the outer border of the tendon of the long extensor muscle of the great toe.

Fig. 272.



Ligation of the anterior tibial, at various parts. The wounds are supposed to be held asunder. The ligature is under the vessel.

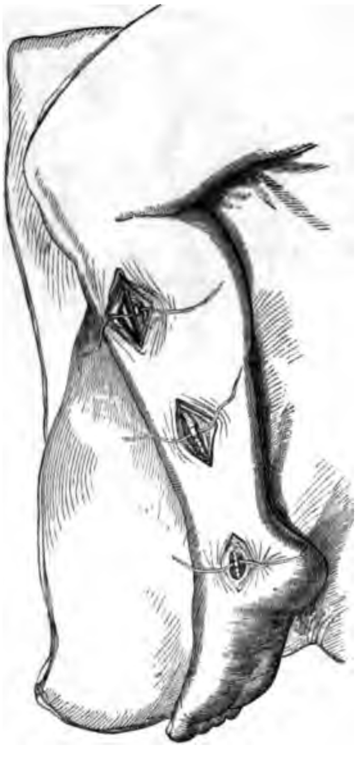
LIGATION OF THE POSTERIOR TIBIAL.

The posterior tibial artery occasionally requires ligation on account of wounds, and, if the operation be performed high up, the task is one of the most arduous and perplexing that a surgeon can be called upon to execute. It has fallen to my lot to tie it in this situation in two instances, and the difficulties in both were very great, having been increased tenfold by the confused condition of the parts, in consequence of the large quantity of extravasated blood. In one of these cases the artery had been laid open by a pistol ball, and in the other by a dirk-knife; the hemorrhage in both was profuse, and could only be effectually controlled by the ligature.

The situation of this artery is very deep; its course is at first obliquely inwards, and then vertical, being indicated by a line extending from the inferior border of the popliteal muscle to the fossa between the heel-bone and the inner ankle. It is covered in the superior two-thirds of its extent by the gastrocnemial, soleal, and plantar muscles, but during the remaining portion it lies immediately below the integuments, except at its commencement, where it is slightly overlapped by the tendo Achillis. It is accompanied and embraced by two veins, one being on each side of it. The attendant nerve lies internal to it in the upper part of the leg, but as it descends it crosses the artery superficially, and places itself along its outer margin. It is not without interest to know that the posterior tibial is sometimes double.

The artery may be exposed and tied in the upper and middle portions of its extent in one of two ways. The first consists in detaching the gastrocnemial muscle for about four inches along the inner border of the tibia, and cutting across the inner head of the soleal, by reflecting which we come directly down to the posterior layer of the aponeurosis of the leg, the free division of which brings the vessel at once fully into view. Care must be taken to avoid the internal saphenous vein, which runs close along the line of incision. In the other method, which was suggested by Mr. Guthrie, the artery is laid bare by a long, vertical cut, extending through the centre of the muscles of the calf. Its advantages are, first, that the artery being more directly approached, is more effectually under our control, and, secondly, that there is less danger of bagging, if blood and pus are poured out. The length of the incision need not exceed that in the other operation, and the hemorrhage is generally insignificant.

Fig. 273.



Ligation of the posterior tibial, at various parts. The wounds are held asunder, and the ligature is under the vessel.

The posterior tibial sometimes requires ligation in the lower portion of its extent, between the heel and ankle. Taking its pulsation for his guide, the surgeon makes an incision, about two inches long, directly along its track, which is nearly midway between the two points here indicated. The direction of the incision should be somewhat curvilinear, with the concavity towards the inner malleolus. The artery here lies beneath three aponeurotic layers, which must be successively divided upon the director, when the needle is passed under the vessel from behind forwards, care being taken not to include the accompanying veins and nerve.

In consequence of the superficial situation of this artery in the lower portion of its extent, a convenient point is afforded between the inner malleolus and the tendo Achillis for the application of pressure in the treatment of hemorrhage of the sole of the foot. The effect may be greatly increased if the circulation be also arrested in the anterior tibial, as may readily be done by placing a compress over it, just above the joint. A bandage is then extended from the toes upwards as far as the ankle, round which it is to be passed in the form of the figure 8, until the bleeding is completely arrested.

Sometimes a metallic arch may be advantageously stretched across the front of the joint, one end resting upon each compress, the object being to ward off injurious pressure.

The two *plantar arteries* begin opposite the two heads of the abductor muscle of the great toe, being the terminal branches of the posterior tibial; they are deep seated, and, when injured, are often a source of troublesome and annoying hemorrhage, owing to the remarkable freedom of their anastomoses. All precepts for exposing and tying these vessels, founded upon their anatomical relations, are useless. The best plan is to be guided by the external wound, and to provide an abundance of room with the knife, always taking care to cut in the direction of the length of the foot.

LIGATION OF THE PERONEAL.

The peroneal artery, after running a short distance, passes obliquely downwards and outwards to reach the fibula, along which it descends until it arrives near the outer malleolus, where it divides into its two terminal branches. It may be secured, in the upper portion of its extent, by making an incision, long and vertical, through the bellies of the gastrocnemial and soleal muscles; and inferiorly, as it runs along between the outer malleolus and tendo Achillis, by a cut at least two inches and a half in length, directed upwards and outwards towards the fibula. The vessel here rests upon the interosseous ligament, under cover of the long flexor of the great toe, which must be detached as far as may be necessary from the bone, and drawn outwards.

CHAPTER VI.

INJURIES AND DISEASES OF THE VEINS.

THE affections of the veins requiring to be noticed under this head are, wounds, hemorrhage, inflammation, varicosity, the formation of phlebolites, and the introduction of air.

SECT. I.—WOUNDS.

Of wounds of the veins not much need here be said, as they rarely exhibit any difficulty in regard to their treatment, or much danger in respect to their termination. Like wounds of the arteries, they may be produced by various weapons, and are, therefore, distinguished by different names, as incised, punctured, lacerated, contused, and gunshot. They are always followed by more or less hemorrhage, according to the size of their caliber, the blood issuing from them in a continuous stream, of a dark, purple color. When the division is complete, there is hardly any retraction, or annular constriction, and hence the bleeding often progresses until it proves fatal, especially if the vessel be large and superficial, as in wounds of the jugular and femoral, fainting not materially favoring the formation of a clot. Partial wounds, of whatever direction, will also bleed copiously, if they are at all extensive, and no mechanical obstacle is offered to the flow of blood. If the incision is small, exhibiting the character rather of a puncture than of a cut, the bleeding, after having continued for some time, will gradually cease, in consequence of the formation of a minute, but gradually increasing, clot upon the edges of the wound. These phenomena may often be witnessed in ordinary venesection at the bend of the arm, the clot adverted to constituting one of the impediments to the flow of the blood, and occasionally compelling the operator to open another vein. In gunshot wounds, severing a large vein, the hemorrhage frequently proves as suddenly fatal, or nearly so, as in corresponding lesions of an artery; or, life being preserved by the narrow state of the wound, or the valve-like disposition of its walls, the blood may be extensively, and perhaps most prejudicially, infiltrated into the intermuscular and subcutaneous cellular tissue.

The chief danger from wounds of the veins arises from loss of blood and inflammation of their tunics. The latter occurrence is occasionally observed as a consequence of the operation of bleeding at the arm with a foul or blunt lancet. In ordinary cases, however, there is but little risk of this kind, the parts readily uniting by adhesive action, since there is no impediment to this process from the sanguineous current, as there is, under similar circumstances, in an artery; all is calm and quiet within, and hence the most extensive wounds are often repaired in an almost incredibly short time.

The *treatment* of a wounded vein is generally very simple, merely by compress and bandage, and attention to position. If seated superficially, we have only to bring the edges of the breach together in the usual manner, and the hemorrhage will generally cease at once, without any direct application to the vein itself. In the operation of bleeding, the only dressing commonly employed, after the necessary quantity of blood has been evacuated, and the edges of the puncture have been approximated, is a small compress, placed immediately over the part, and confined by means of a bandage; the slight inflammation which follows furnishes the requisite amount of plasma, and in less than twenty-four hours the union is generally so firm as to render it difficult to break it. The rule with all good surgeons is never to tie a vein, in any case, or under any circumstances, if it can possibly be avoided; not that such an operation involves any special difficulty, but because of its liability to be followed by severe inflammation, of a diffusive, erysipelatous character, tending to extend into the larger trunks and thence on towards the heart. Cases, nevertheless, occasionally occur, as in wounds and operations about the neck, axilla, groin, and thigh, where, from the extensive character of the lesion, and the impossibility of arresting the hemorrhage by compression, the ligature must be employed at all hazard; and it is gratifying to know that, although such a procedure is perhaps never entirely free from danger, yet it has often been crowned with the most complete success.

Rest is of great moment after wounds of the veins; it should be absolute, for the slightest motion may break up the adhesions, and thus endanger the part by inflammation. Exclusion of the atmosphere is also very desirable, and may be secured by compress and bandage alone, or by these means, aided by collodion.

SECT. II.—DISEASES OF THE VEINS.

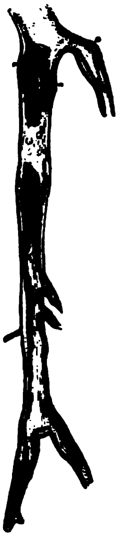
Inflammation of the veins, technically called phlebitis, is occasionally an idiopathic affection; most commonly, however, it arises from injury, inflicted either directly upon these vessels, or indirectly through other structures. It frequently follows upon severe accidents and surgical operations, and, when this is the case, it is apt to give rise to pyemia, or multiple abscess, a disease which, as stated elsewhere, nearly always proves fatal. Phlebitis is a much more common affection than arteritis, and differs from this lesion still further in its liability to terminate in suppuration, which arteritis seldom does, the ordinary product of the latter being plastic matter, not pus. Another peculiarity of phlebitis is its tendency to extend along the vessels towards the heart, thus greatly increasing its dangers. Recent researches, however, render it probable that this tendency is much less frequent than was formerly imagined. The affection is sometimes confined to one vein; but, in general, it involves a considerable number, either simultaneously or successively. In the former case, it is said to be circumscribed; in the latter, diffused. Finally, it may be acute or chronic.

1. ACUTE PHLEBITIS.

The symptoms of acute phlebitis are not always well marked. When the affected vessels are superficial, their course is generally indicated by the existence of a corresponding number of red lines, which, on applying the finger, feel like hard, rigid cords, exquisitely sensitive to the touch, and reaching from the seat of the injury up the limb as far as the eye can follow them. The discoloration, which varies from a faint, rosy tint to deep red, or even purple, according to the intensity of the morbid action, gradually diffuses itself over the surrounding surface, and eventually exhibits all the characters which distinguish that of erysipelas. Considerable swelling usually attends, not unfrequently pitting on pressure. The pain is of a sharp, smarting, or burning nature, and is generally so severe as to deprive the patient effectually of appetite and sleep.

The constitution always deeply sympathizes in phlebitis, even when of comparatively limited extent. The disease is often, if not generally, ushered in by chilly sensations, if not actual rigors, alternating with flushes of heat; the pulse is frequent, quick, and irritable; the skin hot and dry; the stomach nauseated and otherwise disordered; the bowels costive; the urine scanty and high-colored. If the patient was in ill health immediately prior to the attack, the symptoms will usually be of an adynamic character from the beginning; or, if not, they will soon become so. Excessive prostration, delirium, an icterode state of the countenance, gastric irritability, and great restlessness are usually prominent symptoms in every severe case of phlebitis.

Fig. 274.



Phlebitis; a section of the femoral vein, occupied principally by fibrous clots.

The *anatomical characters* of acute phlebitis are swelling, opacity, and pulpiness of the internal membrane of the veins, with uniform redness, varying from light pink to deep florid. The middle and outer coats soon become profoundly injected, and their proper substance, although at first preternaturally soft and humid, is at length rendered so dense and firm that the vein feels like a hard, contracted cord. The cavity of the inflamed vessel is filled with clotted blood, as seen in fig. 274, sometimes blended with pus or lymph, and in many cases it is lined by a false membrane, susceptible, under certain circumstances, of organization. Instances occur in which the pus is infiltrated into the substance of the vein, or collected into small abscesses beneath the serous lining. The pus of phlebitis is generally an imperfectly elaborated fluid, containing a large quantity of plastic matter, and comparatively few characteristic globules.

Acute phlebitis is always a dangerous, and often a fatal, disease, few persons recovering when the morbid action is well established, or extensively diffused. This remark is true both of the traumatic and idiopathic forms of the disease; also of external and internal phlebitis, or of inflammation of the superficial and deep-seated veins. The pus formed in the affected vessels, commingling with the blood, soon poisons the system, and thus renders the heart, brain, and spinal cord unfit for the performance of their functions.

The *treatment* of phlebitis cannot be conducted with too much caution. When the disease is situated superficially, an attempt should be made, by leeches, blisters, iodine, and nitrate of silver, to circumscribe the morbid action, and thus prevent the formation of pus. Such a result, however, is not to be expected when the disease involves the internal or deeper veins, where the inflammation often makes great, if not irreparable, progress before the surgeon is aware of its true character, and where, consequently, treatment of every kind is of little or no avail. All lowering measures are generally inadmissible, even when the patient is comparatively young and plethoric; debility, great and marked, is sure to arise, and to call imperatively for the use of tonics and stimulants. Purgatives are exhibited to clear out the bowels and correct the secretions; and mercury is given in frequent and liberal doses with a view to early and decisive constitutional impression, the best form being calomel, or calomel and blue mass. The addition of morphia will be required for the threefold purpose of preventing undue purgation, allaying pain, and inducing sleep. The best stimulants are milk punch, quinine, and iron, especially the tincture of the chloride.

If abscesses form, their contents must be evacuated by early and free incisions; the internal organs must be diligently watched, and any complications that may arise must be met by appropriate measures.

2. CHRONIC AFFECTIONS.

The characters of chronic inflammation of the veins differ considerably from those of the acute form. The coats of the vessels are usually so much thickened, hypertrophied, and indurated as to preserve, when cut across, their cylindrical figure, like an artery. The redness is of a brownish tint, interspersed with numerous shades of gray, violet, or purple; and the inner membrane, which is rough and shrivelled, can easily be raised in large opaque shreds. In some instances, the vein is dilated, or contracted, obstructed with clotted blood, lined by lymph, or filled with pus.

The disease sometimes passes into *ulceration*, but the occurrence is much less frequent than in the arteries. Commencing most commonly at one or more points of the inner membrane, it gradually extends to the other tunics, which it sometimes completely erodes. The immediate effect of this accident is an effusion of blood, which may be so great as to produce fatal results. The ulcers, which affect various forms, are occasionally quite numerous, and spread over a large extent of surface.

Chronic phlebitis is observed chiefly in the veins of the inferior extremity, and in those of the spermatic cord and of the ano-rectal region, as a complication of hemorrhoids. The principal symptoms are pains, of a sharp, pricking, or dull aching character, tenderness on pressure, and a sense of fulness or distension at the seat of the disease. The treatment is gently antiphlogistic, removal of the exciting cause constituting an object of primary importance.

There are certain states of the system in which the veins attain a very great size, and, consequently, carry an inordinate amount of blood. This *hypertrophy*, for so may it be termed, is very conspicuous in chronic affections of the joints, and in various kinds of tumors, both vascular and malignant. It is always conjoined with hypertrophy of the arteries, and forms one of the most serious obstacles to the cure of certain diseases.

Obliteration of the veins is by no means uncommon, and is almost always the result of inflammation. Sometimes it is caused by the pressure of a tumor forcing the sides of the vessel closely in contact, and so converting it into a dense, ligamentous cord. The largest veins are sometimes thus obliterated. Such a condition is extremely apt to be followed by dropsical effusions and other ill effects inimical to health and life.

Loose concretions, *phlebolites* or vein-stones, as they are termed, varying in size from a currant to a pea, are occasionally found in the interior of these tubes. Commonly of a yellowish, brownish, or bluish color, they are of a hard and brittle consistence, and of an oblong, oval, or spherical form, with a smooth, even surface. When divided, they are found to be made up of several thin but distinct lamellæ, disposed concentrically around a small delicate nucleus, frequently consisting of fibrin. The number of these concretions is extremely variable; occasionally as many as ten, twenty, or even thirty are observed. They are generally met with in the smaller veins; more frequently, perhaps, in the spermatic, uterine, vaginal, vesical, hemorrhoidal, and splenic, than in any other. In the saphenous and its branches, they often exist in connection with varicose enlargement. Their composition is principally phosphate and carbonate of lime, with a small amount of animal matter, probably albumen, and a trace of oxide of iron.

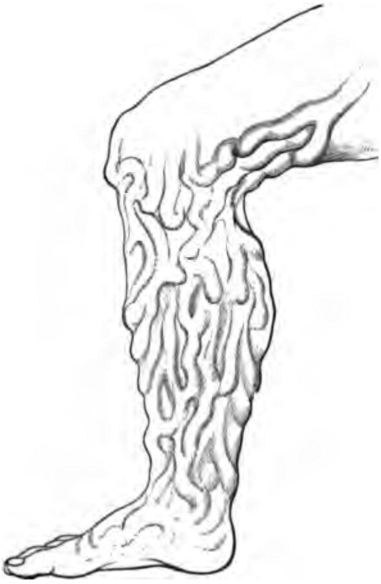
SECT. III.—VARIX.

A varicose and dilated state of the veins is by no means uncommon, especially in the lower classes of working people, and in mechanics whose avocation compels them to maintain habitually the erect position. The veins which are most liable to suffer in this respect are those of the inferior extremity and of the spermatic cord, but those of the abdomen, scrotum, vulva, trunk, and face are also occasionally implicated, while those of the superior extremity are almost exempt from the disease. Of the deep-seated veins, those most frequently affected are the jugular, azygos, subclavian, and hemorrhoidal. I have met with quite a number of cases where there was apparently a varicose diathesis, almost all the principal veins in the body being abnormally tortuous and dilated.

Age seems to exert a remarkable predisposition to this disease. Thus, varicose enlargement of the spermatic veins is most common in young men soon after the age of puberty; while, in the inferior extremity, the greater number of cases occur after the thirtieth year. In the hemorrhoidal veins, the malady is most frequent in elderly subjects.

The veins, in this disease, are preternaturally large, tortuous, knotty, and convoluted, or as if they were folded upon themselves, being augmented both in diameter and length, and observing a singularly serpentine course as they proceed to their place of destination. Their coats are hard, dense, and elastic, rolling under the finger like fine cords; with, here and there, a portion that retains its normal characters, or that is uncommonly thin and expanded, as if it were ready to give way under the slightest exertion. In cases of long standing, they frequently offer a good deal of resistance to the knife, perhaps even emitting a sort of grating noise. On being laid open, they are found to be rough and irregularly sacculated, strong bands being sometimes stretched across their interior, which divide the tube into small cells, occupied by coagulated blood, phlebolites, or fibrinous concretions, in a state of organization. In the advanced stages of the disease, many of the valves are broken down, if not completely destroyed, while in recent cases they are simply thickened, indurated, displaced, or ruptured. These changes, which are generally most conspicuous in the internal saphenous vein and its branches, are obviously brought about by chronic inflammation, or by repeated attacks of the acute form of that disease, and often lead to great and irreparable mischief. Occasionally, the affected vessels are converted into dense, rigid, and impervious cords, altogether disqualified for the discharge of their functions.

Fig. 275.



Varix of the leg.

The state of the vessels here described is well depicted in fig. 275, taken from a patient of mine, a stout, robust laboring man, upwards of fifty years of age. The enlargement, which was much greater than I ever saw it before, was principally situated on the inner surface of the limb, and was associated with similar disease of the veins of the scrotum, penis, and abdomen.

The disease in question may be caused in various ways. In the inferior extremities of pregnant females, it is generally induced by the pressure of the distended uterus, creating a mechanical impediment to the return of the blood in the iliac veins, and, indirectly, in the saphenous. Wearing tight garters, drawers, or stockings, may also occasion the disease, and a similar effect is brought about by the habitual maintenance of the erect posture. Hence, the disease is very common in persons who are compelled to stand much. Varix of the hemorrhoidal veins generally depends upon habitual distension of the rectum and frequent straining in defecation. The causes of varicocele are still imperfectly understood, although there is reason to believe that the disease is most commonly developed under the influence of onanism, and other mechanical obstruction calculated to weaken the spermatic veins.

A natural predisposition to varicose enlargement occasionally exists in certain individuals; the veins seem to be unusually large and feeble, and to become tortuous and dilated under the most trifling obstacles to the onward movement of their contents. When this is the case, the disease often occurs simultaneously in different parts of the body, superficial as well as deep.

The *effects* of varicose veins vary according to the situation of the malady. In the legs, the pressure of the enlarged and distended vessels is always productive of a good deal of pain, of a pricking or stinging nature, of tumefaction of the skin and cellular tissue, and of more or less tenderness along the track of the affected veins. In the more aggravated cases, ulceration of the integuments is apt to take place, commencing usually at one particular spot on the inner surface of the limb, and gradually progressing until a large sore is established, called, from this circumstance, the varicose ulcer, which it is always difficult to heal, and which occasionally extends into the enlarged veins, thus causing copious, if not fatal, hemorrhage. In the spermatic veins, the disease may give rise to atrophy of the testicle, and to distressing neuralgic pains; while in the hemorrhoidal it leads to the formation of piles, and other disagreeable symptoms.

Although the development of varix is generally slow, yet cases occasionally occur in which it progresses very rapidly. During the latter months of utero-gestation, the veins of the feet, legs, and thighs often attain an enormous bulk in a few weeks, and I have seen repeated instances of a similar kind in the spermatic and hemorrhoidal veins. In the inferior extremity, the disease, after having gone on for some time, often remains stationary for an indefinite period, neither perceptibly advancing nor receding. In some instances, it undergoes a sort of spontaneous cure; that is, inflammation is set up in the affected veins, and, this being followed by the formation of fibrinous concretions, their caliber is ultimately rendered completely impervious, thus compelling the blood to seek other channels. Instead of this favorable result, the inflammation sometimes leads to erysipelas, abscess, and even death. Varicocele never proves fatal, nor does varix of the hemorrhoidal veins, although both are, at times, a source of severe suffering.

Treatment.—The treatment of varix resolves itself into palliative and radical. The former consists, as the term implies, of the removal of the exciting cause of the disease, and the adoption of such remedies as are calculated to relieve the part and system of suffering without positively curing the malady. In varicocele, onanism must be interdicted; in varix of the hemorrhoidal veins, straining and constipation must be counteracted; and in varicose enlargement of the veins of the lower extremity, all sources of constriction must be removed, together with whatever else has a tendency to weaken, irritate, and inflame the diseased structures, and thereby occasion further enlargement. Giving artificial support to the affected veins often has a good effect. Hence the use of the suspensory bag in varicocele, and of the laced-stocking in varix of the saphenous veins. In every form of the lesion, great benefit accrues from attention to the general health, and from the occasional administration of an active purgative, which, by clearing out the bowels, thus affords a freer passage of the blood in the diseased veins towards the heart. If the patient be very plethoric, he may sometimes advantageously lose blood. In varix of the legs, nothing commonly affords more prompt and satisfactory relief than a good bleeding at the arm; and the same remedy must be called into requisition, along with astringent and anodyne lotions and perfect rest of the parts, when the veins are unusually tender and painful from an accidental access of inflammation.

For the *radical cure* of this disease numerous operations have been devised, a few only of the more important of which need be noticed here, as the rest have either fallen into merited neglect, or are too dangerous to justify their repetition. Besides, the claims of these different operations will more naturally come to be considered when we speak of the several varieties of varix, as varicocele and hemorrhoids. There are really but two operations which, according to my experience, should ever be resorted to for the permanent relief of this disease; these are the ligature and the caustic issue; and if we apply these remedies to individual forms of the lesion, we shall find that the former is exclusively adapted to varicocele and hemorrhoids, and the latter to varix of the feet, legs, and thighs. Both procedures are extremely simple, but, simple though they be, they should never be employed without a thorough and protracted preparation of the part and system; and I deem this the more necessary, because, in the great majority of cases upon which we are obliged to operate, the disease is rather an inconvenience than a serious evil, threatening loss of limb and life. I will not pretend to assert that there are no cases of varix where an operation is not absolutely necessary; to do this would be absurd; what I mean to say is simply this, that no man, however skilful or experienced, should endanger his patient's life by rushing headlong into measures which, if injudiciously used, may lead to the worst results. The preliminary treatment should be mild but of longer duration than in ordinary diseases; the object is to remove any irritation that may exist in the affected veins, to soothe and calm them, in order that they may be the better prepared to withstand the rude assault about to be made upon them. To accomplish this object the patient must be subjected to light diet, to a course of gentle purgation, and to almost absolute rest in the recumbent or semi-erect posture, for at least a fortnight. This is the more important if he be plethoric, intemperate, or very excitable. When it is remembered how intolerant the veins are of injury, and how resentful they are of surgical interference, such precautions cannot be considered as idle.

The operation with the ligature is either direct, as in piles, or subcutaneous, as in varicocele, and in either case it is as safe as it is effectual. The principle on which it operates is that of strangulation, by which the enlarged vessels are converted into a slough, which is subsequently detached by ulcerative action. For this purpose it is necessary to draw the cord with great firmness, so as to produce the result in question in the shortest possible period, as well as with the least suffering. When the ligation is direct, as in hemorrhoids, it is always necessary to encircle the base of the tumor, or tie it as near as practicable to its point of attachment to the bowel. When the base is unusually large, it is sometimes transfixed with a needle armed with a double ligature, one of which is then drawn around each half of the morbid growth, the object being its more effectual strangulation. The subcutaneous operation is particularly applicable to varicocele, to which, in my judgment, it ought to be exclusively limited. It is performed by means of a stout spear-pointed needle and a strong ligature, introduced in such a manner as to avoid the spermatic cord, the instrument making only two punctures, one in front of the scrotum and the other behind, by retracing its steps after it has effected transfixion. The ends of the cord are then firmly tied in the usual manner, the pressure being increased from day to day until the ligature is detached.

In operating upon the veins of the inferior extremities, I am persuaded that the safest plan is the establishment of a series of issues, made with the Vienna paste, the proper mode of applying which will claim special attention in the section on varix in the second volume.

The *after-treatment* is not to be disregarded in these operations. The great danger is a bad form of erysipelas, connected, doubtless, with phlebitis, its tendency being to diffuse itself extensively over the system, and to give rise to typhoid symptoms. I have not myself, however, witnessed any such effects in any of my cases, and I am inclined to ascribe my good fortune more to the pains which I have always taken to prepare my patients than to any particular skill in performing the operation or in conducting the after-treatment, though no one could be more careful about this than I am. If everything goes on well, little else will be necessary than strict attention to the diet and quietude of the part and system, with an occasional purgative; if erysipelas supervene, calomel, opium, and quinine will be indicated, along with milk punch, and the application of iodine, astringents, and emollient cataplasms.

SECT. IV.—INTRODUCTION OF AIR.

A fatal, though, fortunately, not a common accident, incident to certain operations, is the spontaneous introduction of air into the veins. It is most frequent in operations about the neck, face, and axilla, and was first noticed, as a distinct occurrence, in 1818, by Mons. Beauchesne, in exsecting a tumor from the neck of a young man, in which it was necessary to disarticulate and raise the clavicle. At the moment of effecting this, the patient became faint, and, exclaiming that he was dying, expired in less than half an hour afterwards. The examination of the body revealed the existence of an aperture in the internal jugular vein, at its junction with the subclavian, through which the air, causing the fatal result, had doubtless entered the circulation. Shortly after this, the accident happened to Dr. Mott and Dr. Stevens, as well as to several European surgeons, so that, in due time, the attention of the profession became fully aroused to the nature and importance of the subject.

The disastrous effects of the introduction of air into the venous circulation were known, long ago, to Wepfer, Vander-Heyden, and other physiologists; but they were lost sight of, in great measure, until attention was recalled to the subject by the experiments of Bichat, Nysten, and Magendie, who showed that a very small quantity of this fluid, suddenly injected into the jugular vein of dogs and other animals was sufficient, in most cases, to cause death almost instantaneously. On the other hand, it has been found that a large quantity, as, for example, several cubic inches, will not destroy life, if it be introduced slowly, the air, in this case, combining with the blood in such a manner as to prevent it from producing any serious mechanical inconvenience. Upon dissection, air is readily discovered in the cavities of the heart, as well as in other parts of the circulatory apparatus, thus accounting satisfactorily for the fatal event.

The *symptoms* which characterize the entry of air into the venous system are essentially those of cerebral apoplexy. The patient is generally seized, suddenly and unexpectedly, in the midst of the operation, with a sense of faintness, or a horrible feeling of terror, oppression, and exhaustion, inducing him to believe, and perhaps to exclaim, that he is dying. The countenance, in a moment, assumes a dark, livid hue, the body is agitated with convulsive movements, the breathing is slow, difficult, and stertorous, the muscles are completely relaxed, the pulse is feeble and almost imperceptible, the pupils are dilated, and the individual is wholly unconscious. In short, he dies in a state of profound coma, like a person in a fit of apoplexy. On applying the ear to the cardiac region, the action of the heart is found to be excessively oppressed, the organ struggling powerfully to overcome the mechanical obstruction caused by the admixture of the gaseous and sanguineous fluids, which, swept slowly and heavily along over the fleshy and tendinous columns, occasions a loud, churning noise, synchronous with the contraction of the left ventricle, and at the same time a peculiar thrill, or vibratory sensation, perceptible by the hand as it rests upon the chest.

Such are the effects which are usually observed when air has been introduced suddenly, even in small quantity, into the venous circulation; and there is a strong probability that they will steadily increase in severity until they prove fatal, despite the most judicious and energetic measures that may be employed to counteract them. The period at which death occurs varies from a few minutes to several hours; in some cases life is destroyed almost with the rapidity of lightning, and in most cases in from twenty to forty-five or fifty minutes. The fatal event, if not instantaneous, is always preceded by a rapid reduction of the temperature, and a diffusion of the lividity over the whole body, the surface being of a leaden hue, as in death from asphyxia. Cases have been noticed where, after the symptoms had continued for some time in a very bad form, the purplish appearance of the cheeks was suddenly replaced by a reddish tinge, affording evidence, although generally of a deceptive character, of speedy reanimation and ultimate recovery.

The immediate cause of death, in this accident, has been variously explained; indeed, it is remarkable what little coincidence of opinion there is upon the subject among writers. From the fact that air has occasionally been found in the right cavities of the heart, after surgical operations in man, and in animals after experiments, it has been assumed that it was the inability of this organ to contract upon its contents, and thus send a sufficient quantity of blood to the lungs and brain for the due performance of their functions. Others have maintained that the primary trouble is in the pulmonary tissues. Thus, Mr. Erichsen supposes that it depends upon the manner in which the air and blood are beaten up together in the right cavities of the heart into a spumous fluid, which is unable to pass through the lungs, thus depriving the brain and spinal cord of their due supply of blood, and inducing fatal syncope, usually attended with convulsions. In opposition to this view, it may be stated that, if air be injected in considerable quantity into the carotid artery of an animal, all the phenomena of apoplexy, such as stertorous breathing, loss of sensibility, and spasmodic rigidity of the muscles, will instantly be produced, and soon occasion death from obstruction of the cerebral circulation. Whatever of truth these different explanations may embody, it is evident that the secondary effect of the presence of the gaseous fluid, that which really causes the fatal termination, is the want of a sufficient quantity of oxygenated blood in the great tripod of life, the heart, lungs, and brain.

If the patient survive, the transition to health is seldom instantaneous; on the contrary, several hours generally elapse before he recovers his consciousness and strength. In a case mentioned by Dr. Warren, the man, after having lain in a state of insensibility for two hours and a half, awoke as if from a profound sleep, still breathing, however, like an apoplectic. The night was passed without any accident, and, on the following morning, he was as well as usual, except that he had a headache and some soreness in the chest. Sometimes the patient recovers from the immediate consequences of the accident, but dies afterwards from pneumonia, produced, probably, by the irritating effects which the fluid exerts upon the pulmonary capillaries, and through them upon the air-vesicles. Such an occurrence, however, is infrequent.

The local phenomena accompanying the introduction of air into the veins are of great interest, particularly in their diagnostic relations. In general, there is some noise, or sound, so loud and distinct as to be plainly perceived by the operator and his assistants, and which, occurring in combination with the sudden distress of the patient, is of the utmost value as a means of discrimination. In some cases, the sound is of a hissing nature, like that arising from air rushing into a narrow and exhausted receiver; in some, it is bubbling, clucking, or lapping; in some, gurgling, sucking, or licking. The immediate causes of these variations are, the size, shape, and situation of the opening in the injured vein, the quantity of blood in the wound, and the volume of the vessel and the relation which it bears to the surrounding parts. Whatever may be the nature of the sound, or the degree of its intensity, it cannot, when once heard, be forgotten, and is always clearly characteristic of the accident. In addition to this phenomenon, there is occasionally, but by no means constantly, an appearance of bubbles of air about the wound in the vein, especially if it be somewhat deep seated.

The veins through which air is usually spontaneously admitted in surgical operations are those about the neck, particularly the external and internal jugular and their immediate branches. It may also enter by the veins of the face, the axilla, and the chest. Thus, in one of Dr. Mott's cases, it passed in through the facial vein during the extirpation of an enlarged parotid gland. Dr. Warren met with an instance in which it was introduced by the subscapular vein; Clemot saw it enter by the veins of the chest; and Delpech had a case where it gained admission by the axillary vein. In operations on the trachea, and in the removal of tumors from the anterior part of the neck, the veins lying in this region might easily be wounded so as to let in air.

The reason why the veins in the localities here enumerated are alone subject to this accident is that they are under the influence of a suction action during inspiration, owing to a tendency to the formation of a vacuum within the chest during the expansion of the lungs. This action is naturally limited to the veins at the root of the neck, and it is here, therefore, that air is most liable to be introduced spontaneously; it may, however, as has already been stated, pass in through the veins of the face, axilla, and thorax, but that it may do so it is necessary that these vessels should be found in the condition of rigid tubes, or in a state of canalization, as it has been termed; for if they are merely collapsed, flattened conduits, it is evident that the air will not be able to enter them, however freely they may be punctured. There are various circumstances which may induce this accidental canalization of a vein, of which the principal are the adhesion of its walls to the parts through which it passes, and the manner in which it is held during the operation, rendering it open-mouthed and gaping when divided. Sometimes the introduction takes place in a perfectly healthy vessel at a considerable distance from the root of the neck, in consequence of the tension into which it is thrown by the position of the head and arm, as happened in one of Warren's cases, where the air was admitted by the subscapular vein. The probability of this occurrence is much increased when operations are performed upon the neck, face, and axilla, for the removal of large tumors, especially such as are of a glandular nature, including veins of considerable size. In injury of the jugular veins the accident will be most likely to happen if the wound be made just above the clavicle, where the suction action is naturally strongest. Air thrown into veins in remote parts of the body will destroy life as promptly and effectually as when it enters in the localities above alluded to, and the only reason why the accident does not occur in them is that the vessels are not under the immediate influence of the respiratory organs, as they are about the neck and chest. Legallois witnessed three cases of instant death in female animals from the introduction of air into the inferior vena cava and heart by the uterine veins.

Treatment.—The treatment of this accident is preventive and curative. For the former, different plans have been suggested, most of which may occasionally be adopted with advantage. In the first place, the operator should remember where, and under what circumstances, such an occurrence is most likely to happen; for, being thus put upon his guard, he will be more cautious in the movements of his knife, and thereby, in all probability, altogether avoid the much dreaded mischief. Secondly, when he is about to begin his incisions, he should request an intelligent assistant to compress at the root of the neck any veins that may be within reach, and, consequently, in danger of being injured in the early stage of the procedure. In conducting the deep dissection, he should make careful use of the handle of the scalpel, as well as of his fingers, to detach the morbid structures, or to separate the sound, as the case may be, and if he finds that any veins are included within them, so as to require to be severed, he should secure them at once with the ligature at the cardiac side of the tumor. Sometimes a temporary ligature may be proper to be removed, or tied, after the completion of the operation, according to the exigencies of the case. It has been recommended that, when we are compelled to divide any of the vessels about the neck, the patient should be desired previously to make a full inspiration; such a procedure, however, would hardly be safe unless the vessel should become instantly collapsed, and remain so afterwards. Thirdly, in operating in the different regions under consideration, care must be taken to avoid those positions of the head and arm which are calculated to produce tension and canalization of the veins. Fourthly, it having been found that the entrance of the air into the veins can be prevented in the inferior animals by compressing the chest and abdomen, Mr. Erichsen strongly insists upon the propriety of swathing the body as tightly as the comfort of the patient will admit, with a view of compelling respiration solely by the diaphragm. Not having any experience with this plan, I am not able to give any decided opinion respecting it; but I should be disinclined, on principle, to adopt it, especially if the patient required the use of an anæsthetic during the operation. Lastly, should the accident happen, notwithstanding every possible precaution, as indicated by the occurrence of the peculiar hissing, clucking, lapping, or gurgling noise, previously mentioned, or by the appearance of bubbles about the wound in the vein, compression must instantly be applied, and all further proceeding abandoned until the trouble is effectually remedied.

To recover a patient from the effects of this accident, various methods of treatment have been proposed, some of which are, to say the least, anything but philosophical. The idea of sucking out the air from the injured vein, a plan proposed by some French surgeon, by the introduction of a suitable instrument, such as a silver canula or catheter, amounts to little less than a positive absurdity; for, independently of the difficulty and tediousness of such an operation, it would be far more likely to be followed by an additional introduction of air than the abstraction of that which has been already admitted. But, even granting, for the sake of argument, that a tube could readily be passed into the vein without the risk of letting in more air, it would not be practicable to remove the fluid from the lungs, which it must necessarily reach within a few seconds after the occurrence of the accident. Once admitted, no skill can dislodge it, either by this or any other means. When the patient is plethoric, and has lost but little blood during the operation, it has been recommended to open the temporal artery, on the ground that it might have the effect of removing cerebral and pulmonary congestion, and thus favor the restoration of the circulation. The utter futility of such a procedure must be apparent, when it is recollected that this congestion depends, not merely upon an imperfectly aerated blood, but upon the presence of a spumous fluid, which the capillaries are incapable of propelling onward. The same remarks are applicable to the section of the right jugular vein, which, it has been alleged, might prove beneficial by unloading the corresponding cavities of the heart.

What, then, since the above modes of treatment are unavailing, is to be done for the restoration of the patient? Are there any means upon which we can place any reliance with a fair prospect of success? So far as I know, there are not, and hence our chief, if not sole, dependence must be upon the adoption of such means as may be best adapted to support the system under the terrible depression under which it is laboring. With this view, the treatment should be conducted very much upon the same principles as in syncope from loss of blood, or asphyxia from drowning. The patient is laid at once recumbent, with the head and shoulders lower even than the rest of the body, and, if the circulation be still going on, firm pressure is immediately applied to the axillary and femoral arteries, for the purpose of allowing as free an access of blood to the heart and brain as possible. Sinapisms of the most powerful kind are applied to the extremities, the precordial region, and the spine, in its whole length, and the body is wrapped up in blankets, wrung out of hot water, at the same time that cold air is freely admitted to the nose and mouth. If the patient is able to swallow, he must be made to take brandy and ammonia, otherwise these fluids must be promptly injected into the rectum. Finally, as a *dernier resort*, artificial respiration should be established, by means of a tube, introduced through the glottis, or through an opening in the larynx, and steadily and faithfully maintained, if necessary, until some time after all signs of breathing and circulation have disappeared.

CHAPTER VII.

AFFECTIONS OF THE CAPILLARIES.

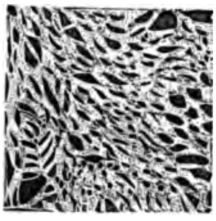
THE capillaries are liable to enlargement, consisting of a species of hypertrophy of their tunics, with more or less dilatation of their caliber. The disease may be limited to the arterial capillaries alone, to the venous capillaries alone, or it may involve both classes of vessels, constituting thus a kind of compound affection. However this may be, the consequence of the enlargement is the formation of a distinct tumor, which may eventually acquire a large bulk, and seriously compromise the safety of the patient, especially when it is of an arterial character. In many cases, if, indeed, not in all, the disease is congenital, having, perhaps, already made considerable progress at birth.

SECT. I.—ARTERIAL TUMORS.

The only arterial tumor, properly so-called, that can be recognized, in a practical sense, is that which was originally so ably and graphically described by John Bell, of Edinburgh, under the name of aneurism by anastomosis. His account of the disease is by far the most clear and elaborate that has yet appeared, and it is remarkable that hardly anything of importance has been added to it by subsequent observers, either as it respects its anatomy, etiology, or mode of treatment. The only error which the Scotch surgeon committed was the assertion that the lesion was peculiar to adults, and that it was a perfect aneurism.

The most common sites of the arterial tumor are the scalp, lip, nose, orbit, eyelid, cheek, and chin; it may, however, occur in any part of the body, and I have repeatedly met with it upon the shoulder, trunk, fingers, and foot. Some years ago, I removed a considerable tumor of this kind from the big toe of a young man of twenty-two. I have also seen examples of the disease in the vulva of young girls. The texture in which it is usually situated is the cellular, especially the subcutaneous and submucous; I do not recollect ever to have seen it anywhere else, though its occasional occurrence has been noticed in the liver, spleen, and kidney.

Fig. 276.



Anastomotic aneurism.

This tumor is essentially composed of a network of arteries and veins, closely connected together by cellular or cellulo-fibrous tissue, as exhibited in fig. 276. It is, in fact, originally nothing but a species of hypertrophy of the capillary vessels, commencing in a little speck, perhaps, not larger than the head of a pin, and going on gradually enlarging until, at length, it acquires an enormous volume. The arteries, which are free from the earthy and fatty degeneration, have a singularly convoluted arrangement, and, in cases of long standing, or of extraordinary bulk, some of them are often as large as a small goose quill; their walls are disproportionately thin and diaphanous, and from being pressed out laterally into short, blind pouches, it is very common for them to have a sacculated appearance. This increase in the caliber of the arteries is not limited to the tumor, but always extends some distance beyond its proper boundaries, as can readily be ascertained by a careful examination with the finger; in fact, it is sometimes easily detected with the naked eye. The general disposition of the veins is similar to that of the arteries; they are, however, usually less capacious, relatively considered, and hence the blood returns with less facility than in parts naturally constituted.

The tissue by which the vessels are connected together is, in the first instance, nothing but ordinary cellular substance, naturally existing in the part where the tumor is developed; it is perfectly soft, spongy, and extensible. In time, however, it necessarily undergoes important changes, brought about by the pressure exerted upon it by the impetuosity of the inflowing blood, and by its temporary sojourn in the midst of the morbid mass. Hence it is that, while in some situations it exists most sparingly, so much so, indeed, as to be hardly demonstrable, in others it is preternaturally abundant, and truly cellulo-fibrous.

Such are the grosser elements of this form of tumor. Examined more minutely, it is found to consist of a kind of areolar structure, the cells of which, varying in size from that of the smallest pin's head to that of a pea, freely communicate with each other, not unlike those of a sponge, by means of lateral pores. These cells, which exhibit every diversity of shape, are formed apparently by the ampullar expansions of the coats of the arteries, and bear, in their general character, a considerable resemblance to those of the erectile organs, as the penis and clitoris. In old tumors of this description, some of the sacs occasionally become closed, thus assuming, as it were, an independent existence. The cause of this occurrence is probably inflammation, leading either to direct adhesion of the contiguous surfaces of the arteries, or to the formation of coagula. The contents of these cysts are either serous, sero-sanguinolent, or sanguineous. In the latter case they are generally solid.

Finally, the arterial tumor has no distinct, separate envelop; the only covering which it has is derived from the superincumbent structures, as the skin or mucous membrane, which, in time, become atrophied by the incessant beating of the blood beneath, and ultimately give way by ulcerative action. In general, the surface of the tumor is of a reddish scarlet hue, with, here and there, a purple spot, and so transparent as to allow many of the enlarged vessels to be seen through it. Occasionally a few granules of adipose matter overlie the tumor, or are dispersed through its substance.

It will thus be perceived that this tumor is in reality not a true aneurism, preceded and accompanied by the fibrous, earthy, or atheromatous degeneration, but simply an abnormal dilatation of the capillary arteries, involving, in time, the larger arteries in their immediate vicinity, and attended by a corresponding but less developed state of the capillary and adjacent veins. It consists, in fact, clearly and distinctly, in a hypertrophied condition of these vessels; or, in other words, as was previously remarked, in a gradual evolution and growth of arteries and veins from tubules that are imperceptible by the naked eye to vessels of extraordinary size. There is no addition of new vessels, but the whole tumor is formed out of those which naturally exist in the part, enlarged in every direction, in length as well as in diameter, under the pressure of the increased and ever-present afflux of blood. The coats of the vessels are not, it is true, as thick and firm as those of arteries and veins, properly so-called, usually are, but the aggregate capacity is so much greater than what the part naturally possesses that it must be regarded as a product of supernutrition, and nothing else.

The origin of the arterial tumor is often ascribed to the effects of external violence, as a blow or fall, and that it may occasionally be so excited is highly probable; in general, however, it arises without any assignable cause, as a nevus, or mother-mark. Indeed, I am inclined to think that the affection is nearly always congenital, even in those cases in which it is said to have begun in the adult. This may be accounted for on the assumption that the nevus was originally so exceedingly minute as to have entirely escaped attention, until it began to assume an active character. However this may be, the starting-point of the disease is usually a little reddish speck, not larger than the head of a small pin, perfectly free from pain, and seated just beneath the skin, or partly in the skin and partly in the subcutaneous cellular tissue. Its growth is generally very gradual, so that a number of months, and perhaps even several years, may elapse before it attains the volume of a pigeon's egg. Occasionally, however, it increases with great rapidity, and soon acquires a frightful bulk. Of this occurrence I had a striking illustration, not long ago, in a female child, thirteen months old. At birth a reddish spot, as large as a dime, was observed at the centre of the left cheek. At the end of five weeks it had nearly doubled its dimensions; a quack now applied some caustic substance, eventuating in a large slough. The sore, which was the seat of occasional hemorrhage, healed in a little more than two months, leaving an unseemly scar, upwards of two inches in diameter, with red, spongy edges. A year after the use of the escharotic, when I first saw the child, the tumor was of immense volume, horribly disfiguring the features, and occupying the whole of the left side of the face, extending forwards to the nose and mouth, upwards to the eyelid and temple, backwards behind the ear, and downwards into the neck, its antero-posterior diameter being eight inches and a half, and the vertical six. The tumor, of a bluish color, was of a soft, spongy consistence, and sensibly increased whenever the child cried, laughed, sneezed, or coughed. At its lower and back part it had a peculiar aneurismal thrill and bruit, synchronous with the action of the heart. During the last few months the inside of the cheek had become much enlarged, and now presented a knotty feel and bluish appearance. The upper jaw, along its alveolar process, was of unusual size, evidently from the same cause, and was beginning to encroach seriously upon the mouth. The swelling was free from pain, and there was no disorder of the general health.

In general, however, the tumor proceeds more slowly, and it is not uncommon to meet with cases, in which, after having made some progress, it remains for a while stationary. When it begins as a nevus, it is not unusual for it to continue as a little reddish spot for several years, when, its activity being aroused, how or why we know not, it grows with unwonted vigor, and soon attains a large bulk. The tumor has generally an irregular outline, and rarely projects more than six or eight lines beyond the level of the surrounding parts. It is soft and compressible, the finger sinking into it as it would into a wet sponge, but the moment the pressure is removed it immediately regains its former situation. Its color varies in different cases; when it occurs in the skin, or skin and cellular tissue, it is generally of a reddish hue, inclining to scarlet, especially in its earlier stages; but in old cases, and when it lies beneath mucous membrane, it is more commonly of a bluish or purplish color. It beats and throbs synchronously with the contraction of the left ventricle of the heart, and imparts a peculiar aneurismal thrill to the finger. Its movements are often perceptible at a considerable distance, and are always sensibly augmented under the influence of mental emotion. When of considerable volume, the tumor may produce severe pain and other inconvenience by its pressure, but in most cases there are but little local suffering and constitutional disorder.

Such a tumor sometimes ulcerates and sloughs, causing more or less hemorrhage, and ultimately perhaps death. Some years ago, I saw a female child, aged ten months, who had a congenital arterial nevus upon the right shoulder and arm, which gradually extended down towards the elbow; it was of a dark purple color, and of a soft, spongy consistence, throbbing and beating violently. The general health was good, but after some time ulcers began to form on different parts of the tumor, which now became very painful and inflamed; in a few weeks more gangrene set in, and, gradually progressing, soon destroyed the little patient. The hemorrhage which succeeds the ulceration of this tumor, although sometimes very profuse, seldom proves fatal; after the bleeding has continued for some time, the blood coagulates upon the abraded surface, and thus affords the vessels an opportunity of preventing further effusion. In the female, the hemorrhage is occasionally vicarious of the menstrual flux; the tumor becomes full and tense at the return of each period, and, giving way at the top, allows the blood to drain off, without serious injury to the part or system. It has been asserted that such a growth may degenerate, changing its primitive character, and assuming one of a worse kind, as the medullary or melanotic. Without altogether denying the possibility of such an occurrence, I have never seen any cases in my own practice to justify the conclusion.

Treatment.—The treatment of this form of tumor may be conducted by excision, escharotics, strangulation, injections, starvation, and, lastly, by amputation, as when the disease occupies one of the extremities. Besides these methods, there are several others of a more doubtful and less trustworthy character, which will be briefly noticed in their proper place.

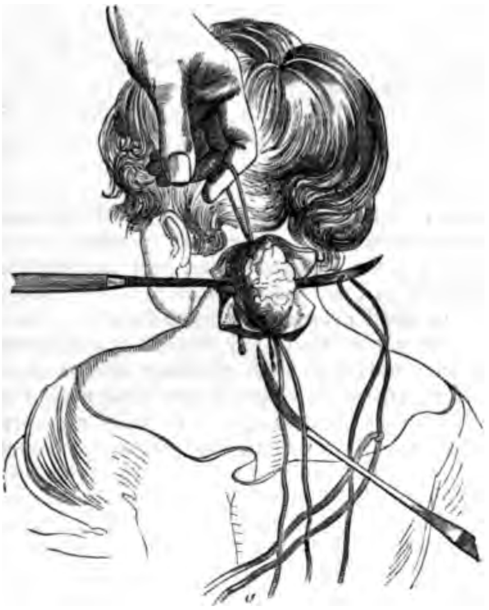
a. Excision is chiefly adapted to small arterial tumors, before they have acquired much functional activity, or given rise to any marked enlargement of the neighboring arteries. The operation is then perfectly safe, easy of execution, and likely to be entirely successful. But if we wait until the tumor has attained a large bulk, beating and throbbing violently at every pulsation of the heart, as if it were ready to burst, the attempt, besides proving one of immense difficulty, may be attended with so copious a hemorrhage as to cause speedy exhaustion; we have then a formidable enemy to deal with, and we may consider ourselves happy if we do not let our patient perish from the loss of blood, gushing forth, as it will, in torrents, at every stroke of the knife. In such a case the prudent surgeon weighs well, before he begins his perilous operation, the chances of his success; he measures every inch of the unexplored territory, and equips himself thoroughly, at every point, for the trials and perplexities of his portentous undertaking.

When excision is determined upon, the rule of practice is, as John Bell long ago so correctly observed, not to cut into the tumor, but around it, and yet not so widely around it as to include an unnecessary quantity of sound tissue. The operation is performed rapidly, the finger of a good assistant quickly following the knife in order to compress any important artery that may be divided, until the whole mass is completely extirpated; and it will be wise, if practicable, always to arrest the circulation in the main artery leading to the tumor before we begin our incisions. Removal being effected, upon the principle here enjoined, the ligature may often be entirely dispensed with, all bleeding ceasing the moment the operation is over; or as soon as the edges of the wound are thoroughly approximated by the twisted suture, a mode of dressing peculiarly adapted to this form of disease, on account of the hemostatic influence exerted by its compression.

b. Small arterial tumors may often be readily destroyed by *escharotics*, of which I have found the Vienna paste to be preferable to any other, used as in making an ordinary issue. The paste is retained for fifteen minutes, being spread out sufficiently to cover the whole of the affected surface; the application is followed up by an emollient poultice, and when the slough is detached the sore is treated upon general principles. When the tumor is very large, and so situated as not to involve any important structures, interference with which might prove prejudicial, it may be attacked, either simultaneously or successively, at several points of its extent, for the purpose of converting the whole mass into an eschar. For obvious reasons the caustic should not be used upon those parts of the body which are habitually exposed, as the face and neck.

c. Strangulation may be effected by transfixing the base of the tumor with one or more needles, and then drawing a ligature firmly around them, so as to cut off at once, and effectually, its sanguineous supply. Or, instead of this, a stout double thread may be conveyed beneath and around it by means of a spear-pointed needle, provided with an eye, one cord being tied upon one side of the swelling, and the other upon the opposite side. If the integument be sound, the ligation is preceded by its careful division and reflection, as in fig. 277, in order that, when the morbid growth has been removed, it may be replaced, and thus serve to protect the parts from an unseemly cicatrice.

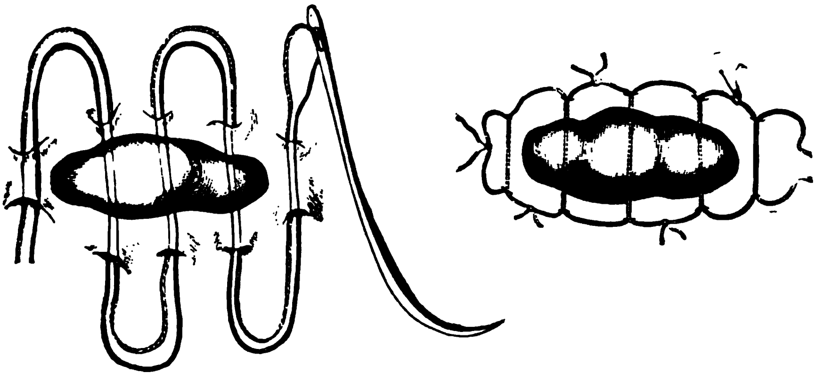
Fig. 277.



Erectile tumor. The integument, uninvolved, has been reflected by flaps. Transfixion is being completed, previous to deligation. *a.* The larger ligature, in the act of being pulled through. It fills the aperture of puncture, preventing bleeding; and, besides, bears a stronger strain in the tying.

When the tumor is so flat and elongated as not to admit of inclusion by the quadruple ligature, recourse may be had to the ingenious expedient of Erichsen, which combines the great advantage of thorough strangulation with a small ultimate cicatrice, it being unnecessary to embrace an undue quantity of integument for the eradication of the disease. The operation is performed in the following manner:—"A long triangular needle is threaded on the middle of a whip-cord, about three yards in length; one half of this is stained black with ink, the other half is left uncolored. The needle is inserted through a fold of the sound skin, about a quarter of an inch from one end of the tumor, and transversely to the axis of the same. It is then carried through, until a double tail, at least six inches in length, is left hanging from the point at which it entered; it is next carried across the base of the tumor, entering and passing out beyond its lateral limits, so as to leave, as shown in fig. 278, a series of double loops about nine inches in length on each side. Every one of these loops should be made about three-quarters of an inch apart, including that space of the tumor, and the last loop should be brought out through a fold of healthy integument beyond the tumor. In this way we have a series of double loops, one white, and the other black, on each side, as in fig. 278. All the white loops should now be cut on one side, and the black loops on the other, leaving hanging ends of thread of corresponding colors.

Fig. 278. Fig. 279.



Erichsen's mode of ligating vascular tumors.

"The tumor may now be strangulated by drawing down and knotting firmly each pair of white threads on one side and each pair of black ones on the other. In this way the tumor is divided into segments, each of which is strangulated, by a noose and a knot: by black nooses and white knots on one side, by white nooses and black knots on the other, as in fig. 279."

d. Starvation may be attempted in one of two ways; either by tying the arteries which immediately feed the tumor, or else by occluding the main vessels which lead to the parts where the tumor is located. Of these two methods, preference should always, if possible, be given to the former, on account of its having a more direct and controlling influence upon the arrest of the morbid growth; when the swelling is very large, the two plans may sometimes be advantageously combined. Ligation of the arteries in the immediate vicinity of the tumor should be performed at several points at once, otherwise but little impression will be likely to follow; and care is taken, in performing the operation, not to interfere with the proper substance of the tumor, lest embarrassing hemorrhage ensue.

Deligation of the main artery leading to the parts upon which the morbid growth is situated has hitherto been practised chiefly upon the common carotid, in aneurism by anastomosis of the orbit, face, and scalp. The success has been variable, but, in the main, not very flattering, and yet I conceive that the procedure may be very proper when no other treatment is available. The misfortune, perhaps, is, that it is always employed as a *dernier resort*, and it is, therefore, not surprising that it should have so often failed. Dr. Mott, many years ago, tied the common carotid artery on account of a large arterial tumor, involving both orbits, the nose, and part of the forehead, in a child only three months old; the mass gradually diminished in size, and became so much consolidated as to lead to the belief that it might afterwards be extirpated, if such a measure should be deemed expedient. The final result of the case has not been reported. In 1828, I assisted Dr. George McClellan in taking up the right common carotid for the cure of an aneurism of the corresponding side of the face and orbit, in a child five months old. The operation seemed to arrest the growth of the tumor for a fortnight, but, at the end of that time, its activity was again aroused, and it went on gradually and steadily increasing until it caused death by hemorrhage and constitutional irritation. Dr. Mussey, Dr. J. Mason Warren, and others, both of this country and of Europe, have tied both carotids for the cure of this disease. The first of these surgeons applied the second ligature, after an interval of twelve days, without the occurrence of any untoward symptoms.

In the case of Dr. Warren, a little upwards of a month elapsed between the first and second operations; no unpleasant effects supervened, and the patient, a man aged twenty-three years, made a rapid recovery, although the arterial tumor was of enormous size, involving the mouth, face, and neck. Professor Kuhl, of Leipsic, tied the left carotid in a man of fifty-three, and, in forty-one days afterwards, the right carotid, on account of an extensive arterial disease of the scalp. The patient recovered, but not without considerable cerebral disturbance and repeated hemorrhages from the tumor. In tying two such large arteries for the cure of this affection, it is important to allow a sufficient period to intervene between the two operations for the dilatation of the collateral vessels which supply the brain, so as to enable this organ to obtain the requisite supply of blood for the proper execution of its functions. Several cases, it is true, have lately been published, in which the ligation was performed after a very brief interval, without any serious detriment to the cerebral circulation, yet this fact does not invalidate the necessity of this precaution in the class of maladies in question.

Mr. Oliver Pemberton, in a paper in the London Lancet, for May, 1860, has adduced some valuable statistics upon this subject. Of 35 cases in which the ligature was applied to the principal trunk of the artery leading to the tumor, 14 were cured, 10 died, 9 were unsuccessful, and in 2 the result was imperfectly given. In 6 of these 35 cases the operation was performed for vascular growths of the orbit, and, of these, 5 were cured. In 10 other cases in which the branches of the main artery were ligated, not one was permanently relieved.

e. Of the various *injections* that have been used for the relief of this tumor, the principal are nitric acid, creasote, iodine, and perchloride of iron, introduced in small quantity, either pure or diluted, with a delicate syringe, similar to that spoken of under the head of aneurism. These fluids are all more or less irritating, while several of them are capable of exciting high inflammation; hence it is hardly necessary to add that they should be employed with the greatest possible care and gentleness. At least one case is upon record, where a drop of nitric acid, injected into a small arterial growth of a child, caused death by convulsions.

The only really unobjectionable injection, for the cure of this disease, is a strong solution of persulphate of iron, a few drops of which may be deposited in different parts of the tumor, by means of a delicate syringe, the nozzle of which, introduced subcutaneously, is moved about in such a manner as to break up the coats of some of the capillary vessels. Coagulation occurs almost instantaneously, and in the course of from five to ten days, the whole growth drops off in the form of a slough, leaving a sore which gradually heals by granulation. By means of this salt, which is now rapidly coming into use as a hemostatic, I am satisfied that any case of arterial or venous tumor, unless very bulky, may be promptly and effectually cured.

f. Finally, among the subordinate and less certain remedies may be mentioned the use of heated needles, the seton, vaccination, and compression.

The introduction of *heated needles* into the midst of the morbid growth was strongly recommended, some years ago, by several American surgeons, who followed up the suggestion by the publication of a number of cases illustrative of its efficacy. On the strength of these reports, I was induced to make trial of the remedy in a number of instances which fell into my hands shortly afterwards, but such was my disappointment that I soon abandoned it altogether. My opinion is that few practitioners now employ it, or have any particular confidence in its efficacy. In performing the operation, which is adapted only to very small arterial tumors, a number of slender, sharp-pointed needles, generally as many as three, four, or five, inserted into a wooden handle, and heated red, are thrust into different parts of the morbid growth, where they are retained until they become cool, when they are withdrawn, the introduction being repeated every three or four days, the object being to provoke an effusion of plasma. Besides the pain attending this procedure, such is its uncertainty, that it is questionable whether it deserves a place among the regular and accredited remedies for the cure of this disease.

A few cases of cure of the arterial tumor by *vaccination* have been reported. The remedy is, of course, applicable only to persons whose system has not been previously protected by this operation; and it is necessary, in order to be successful, that the virus should be inserted at different points, so that the effects of the resulting inflammation shall be deeply felt by the whole growth. The operation is sometimes followed by violent inflammation and high constitutional disturbance, threatening convulsions, and other serious accidents.

The *seton* is, perhaps, on the whole, more reliable than any other of these subordinate remedies; introduced underneath the tumor, and left there till suppuration is fully established. If the growth be small, a single thread may suffice, otherwise three or four may be necessary, or, perhaps, even a larger number. A small needle, inserted into a handle, is used, the cord being dragged through so as to fill the puncture made by the instrument, thereby preventing hemorrhage. I have treated three cases of small arterial tumors on the scalp successfully by this method.

Compression is sometimes employed, generally through the medium of the pad of a truss, or of a piece of ivory, coin, or sheet lead, confined by adhesive strips and a roller. To prove efficient, it must be made in a steady, uniform manner, the cases to which it is chiefly adapted being those in which the tumor is diminutive, and situated upon a hard, bony surface. The procedure is exceedingly unsatisfactory.

g. When the tumor is irremediable by the various measures now described, and is so situated as to admit of it, *amputation* may become necessary. Much as such a step is to be regretted, no one, I conceive, should hesitate to take it when the disease occupies a finger, hand, arm, foot, leg, or thigh.

SECT. II.—VENOUS TUMORS.

Under this head may be described a morbid growth, composed chiefly of dilated and varicose veins, held together by connective tissue; situated, for the most part, upon the scalp, cheek, lip, and chin, but also liable to occur in other regions, as the trunk and extremities. The submucous cellular substance of the mouth, tongue, and vulva may, likewise, be mentioned as occasional seats of the disease, and there is one form of hemorrhoidal tumor which evidently closely assimilates itself to it in structure. Varying in size and prominence, it may, originally, not be larger than a small pimple, which, gradually spreading in different directions, may ultimately acquire an extraordinary bulk, forming a considerable projection, and occupying a diameter many inches in extent. Its color is usually purple, or claret, either continuously, or intermixed with various shades of red; occasionally it is dark-mottled, especially when the enlarged veins lie nearer the surface at one point than at another, thus rendering their contents distinctly visible through the attenuated integument. In its consistence it is soft and spongy, diminishing sensibly under pressure, but speedily regaining its former bulk when the pressure is removed. It is free from pulsation, bruit, and expansion, and is comparatively little influenced by mental emotion. Sometimes the growth is tardy, at other times rapid; it is usually congenital, but may occur at any period of life; sometimes, and most generally, without any assignable cause, and at other times as a consequence of external injury. At first there is commonly no cutaneous involvement, the tumor being strictly limited to the cellular tissue; by and by, however, the skin becomes uniformly attenuated, or thickened at one spot, and atrophied at another, and thoroughly incorporated with the morbid structure. As the disease advances, but generally not until the tumor has attained considerable bulk, ulceration may take place, followed by occasional hemorrhage, chiefly of a venous character, and easily checked by pressure.

The venous tumor consists of a network of dilated capillaries, not of new development, but simply an exaggeration of those which are peculiar to the part where the morbid growth is situated. They are connected together by loose cellular tissue, are more or less tortuous in their disposition, and have exceedingly thin, delicate walls, so that, when a body of this kind is excised, they immediately collapse, the structure, which previously formed a large mass, shrinking away into a little, spongy remnant. In the specimens which I have had an opportunity of examining, no abnormal vascular cells or fibrous bands were distinguishable; and, as the operations performed for their removal were almost bloodless, it is evident that the arteries which entered into their composition must have been exceedingly small and few in number. In very old and large growths of this kind, some of the individual veins are occasionally of enormous size, as well as remarkably tortuous, and contain fibrinous and earthy concretions, lodged in separate compartments. Such occurrences are most frequently met with in venous tumors on the trunk and buttocks.

The venous tumor is most easily dealt with by excision, and, unless the growth be of inordinate volume, such a procedure will be almost bloodless. Should any considerable artery be embraced in the general mass, it must, of course, be secured, either during the dissection, or immediately after it has been completed. The same rule of cutting round the tumor, and not into it, should be observed here as in the removal of arterial growths.

When the knife is objectionable, a venous tumor, if small, may readily be destroyed by the subcutaneous injection of a few drops of a strong solution of persulphate of iron. The procedure is perfectly safe, and productive of but little suffering. I have performed the operation in several cases with very gratifying results. The diseased tissues usually slough off in from five to eight days. Such growths may also be readily destroyed by strangulation, either with the ligature alone, or with the ligature and needle, in the form of the twisted suture; if very large, however, they must not be meddled with in this way, otherwise, violent inflammation arising, the operation may prove fatal.

CHAPTER VIII.

DISEASES AND INJURIES OF THE BONES AND THEIR APPENDAGES.

THE bones, being organized upon the same principles as the soft structures, are liable to similar diseases, both of a benign and a malignant nature. The presence of earthy matter, however, to which the bones are indebted for their solidity and strength, so as to render them fit organs for locomotion, exerts, as is well known, a modifying influence upon their diseases, not only as it respects their frequency, but also their progress, the character of their products, and the mode of their termination. This influence is particularly noticeable, on the one hand, in the difficulty with which inflamed osseous tissue suppurates, and, on the other, in the facility with which it becomes softened and deprived of its vitality, even, apparently, under very slight action. Inflamed soft texture generally suppurates with remarkable readiness, and often becomes the seat of large abscesses; in pure osteitis, on the contrary, pus is rarely seen in any form, much less in that of abscesses, such an occurrence being usually impossible, first, on account, it may be supposed, of the peculiar habits of the secernent vessels, and, secondly, because of the absence of free cellular substance, which, in the soft tissues, always serves as a bed for the reception and accommodation of the purulent fluid. Bones inflame with difficulty, but when the morbid process is once fairly lighted up, it is sure to produce serious structural disorder, often followed by the worst consequences, as softening, protracted ulceration, hypertrophy, fragility, and even necrosis, or the death of the affected parts. In tertiary syphilis, gout, rheumatism, and scurvy, the bones frequently suffer immensely, receiving and harboring disease with great facility. They are a common seat of various kinds of tumors, especially the benign, some of which, as the exostoses, are very similar to, if not identical with, their own structure, while others are essentially different in most particulars. The heterologous formations have all been observed in the skeleton, but their great rarity has been a subject of remark by every systematic writer. The most common of these formations is the tubercular, which plays so important a part in caries of the carpal and tarsal bones, in Pott's disease of the spine, and in strumous affections of the larger joints of the extremities.

SECT. I.—PERIOSTITIS.

The occurrence of periostitis is by no means infrequent, its causes being those of osteitis, with which, especially in its acute form, it is usually associated. Among the most common of these causes are various kinds of external injury, such as fractures and dislocations, blows, contusions, gunshot wounds, and the application of escharotic substances; and the effects of gout, rheumatism, and syphilis, operating upon a disordered and broken-down state of the system. There is one form of whitlow which consists essentially of periostitis, attacking usually one of the fingers, and liable, if neglected or improperly treated, to terminate in extensive suppuration and necrosis of the distal phalanx. Inflammation of the periosteum, of a very severe and destructive nature, is occasionally produced by deep-seated abscesses, extending to, and irritating that membrane, as happens, for example, sometimes in phlegmonous erysipelas, where the matter burrows extensively among the surrounding tissues. Two forms of the disease are met with, the acute and chronic, the latter being the more common.

ACUTE PERIOSTITIS.

In the acute form of inflammation, the fibrous membrane is somewhat discolored, being commonly of a reddish, pink, or lilac hue; its vessels are loaded with blood, and its substance is sensibly softened, as well as slightly thickened from interstitial deposits. Its attachment to the bones is also considerably diminished, so that it may be pretty readily peeled off, and the cellular substance immediately over its outer surface is generally infiltrated with sero-albuminous matter. These changes, which are present, in greater or less degree, in all cases of periostitis, are often very conspicuous upon the fragments of a broken bone, and in incised wounds of the muscles, involving the membrane in question.

The disease not unfrequently passes into suppuration, the occurrence being particularly liable to happen in the periosteum of the bones of the inferior extremity, as the femur and tibia, and in the phalanges of the thumb and fingers; in the former as a consequence of cold acting upon a strumous constitution, or of the effects of mercury, or of mercury and syphilis, and in the latter as a result of whitlow. Much diversity exists in regard to the progress of the suppurative action; most generally it is rather tardy, but there are cases in which it proceeds with extraordinary rapidity, committing excessive ravages in a few days. However this may be, the pus is rarely of a healthy, laudable nature, but almost always very thin, bloody, and offensive, with flakes of curdy matter and the *débris* of broken-down, softened tissue.

Mortification is another termination of this disease, the occurrence being characterized by the dirty, ash-colored appearance of the affected membrane, which is, moreover, very much softened in its texture, and saturated with a foul offensive fluid, emitting an unmistakably gangrenous odor. Such an event is necessarily associated with necrosis of the corresponding bone, and frequently, also, with mortification of the endosteum, all perishing together in consequence of the destruction of their vascular connections. The best examples of this mode of termination occur in the periosteum of the alveolar processes of the jaws, from the abuse of mercury, and in that of the tibia from the effects of syphilis. The sloughs, which are always tough and shreddy, are usually thrown off with considerable difficulty, owing to the tardy and imperfect action of the circumjacent structures.

Symptoms.—The symptoms of periostitis are such as usually attend inflammation of the deep-seated structures generally, the pain being of a violent and pulsatile character, and the swelling of the soft parts diffuse and œdematous, with excessive heat of surface, and more or less constitutional disturbance. The occurrence of suppuration is announced by a marked increase of suffering; and as the pus accumulates the superincumbent integuments assume a shining, glossy, erysipelatous aspect, pitting under pressure, and imparting a distinct sense of fluctuation. Both in suppuration and mortification the pain is exquisite, and the patient generally labors under high fever and often also under delirium.

In periostitis consequent upon a syphilitic taint of the system, the suffering is always worst at night, the pain being of a severe, aching, or gnawing character, and invariably aggravated when the patient becomes warm in bed. Small, circumscribed swellings, or nodes, frequently exist, and are exquisitely tender on pressure and motion, the skin over them being red, inflamed, and œdematous. The contents of these swellings are generally of a thick gummy character, possessing none of the properties of genuine pus.

In gouty and rheumatic periostitis the pain is deep-seated, wandering, or migratory, and generally very severe; the soft parts over the seat of the disease are discolored, glossy, and puffy; slight effusions of sero-plastic matter often exist beneath the affected membrane, forming small, rough, and irregular swellings, which are easily detected by the finger; the system is disordered by fever; the perspiration is acid and copious; and the urine is scanty and high colored, depositing a large quantity of lateritious substance upon the bottom of the receiver. The most reliable symptoms, in a diagnostic point of view, are, the shifting character of the disease, the involvement of the joints, and the history of the case.

Treatment.—In the treatment of periostitis, a primary object is to seek for the cause of the disease, and, if possible, to remove it. The traumatic form is to be managed upon ordinary antiphlogistic principles, and need not, therefore, detain us here. Idiopathic periostitis is often a self-limited affection, tending to terminate in suppuration, despite the best directed efforts of the surgeon. Examples of this constantly occur in whitlow and in some varieties of necrosis, in which periostitis commonly plays an important part, the morbid action being apparently dependent rather upon some inscrutable constitutional trouble than any special local cause. General treatment can seldom be altogether dispensed with in any case, while in many it constitutes our most valuable resource, no progress of a favorable character being made without it. In the more severe forms, bloodletting, active purgatives, and the saline and antimonial mixture, will probably be required, along with anodynes, to allay the excessive pain which is so often present. The most important topical remedies are leeches, iodine, blisters, and saturnine lotions with laudanum. If great tension exist with a tendency to suppuration, deep-seated incisions are made, without waiting for fluctuation, which is often extremely difficult of detection, unless the affected structure happens to be very superficial, as in periostitis of the tibia. The necessity of this operation cannot be too strenuously insisted upon, as it is the only way in which we can afford prompt relief to the suffering, and obviate extensive and irremediable mischief, as must inevitably be the case when the matter is permitted to burrow. When mortification takes place, the same treatment must be adopted as under ordinary circumstances.

In syphilitic periostitis the best remedy is iodide of potassium, in doses of from five to ten grains three times a day, either alone or in union with bichloride of mercury. If nodes form, they will generally disappear under the influence of the application of iodine, blisters, or mercurial inunctions, and will seldom demand interference with the knife.

Rheumatic and gouty periostitis will require the use of colchicum, with systematic purgation, and occasionally, perhaps, slight ptyalism, with leeches, fomentations, and alkaline and anodyne liniments.

CHRONIC PERIOSTITIS.

The periosteum is often the seat of chronic inflammation, its substance becoming thickened and indurated from the effusion of plastic matter. The hypertrophy—for so it may be termed—often involves a considerable extent of surface, forming a diffuse, incompressible swelling, fibrous, cartilaginous, or even osseous in its character. Sometimes, on the other hand, the enlargement is very small and circumscribed, not exceeding, perhaps, the end of the little finger or half a dime. It may be caused by some specific constitutional poison, especially the syphilitic, or by external violence, as a blow, fall, or kick, as is often the case when it exists on the skull. However induced, its development is attended with a constant, deep-seated, gnawing pain, which is usually most severe at night when the body becomes warm in bed, and which occasionally assumes a true neuralgic character. After continuing for an indefinite period, it often remains stationary, or it gradually disappears by absorption, or it excites suppuration in the superimposed tissues.

These chronic affections of the periosteum are generally peculiarly obstinate and intractable, requiring specific remedies, frequently varied and long continued, for their cure. Iodide of potassium and mercury, Donovan's solution, and the different preparations of arsenic, with blisters, iodine, leeches, the vapor bath, and mercurial fumigations, are the means most likely to prove beneficial. In obstinate cases, resisting the ordinary remedies, free incisions, extending through the substance of the thickened and indurated membrane down to the very bone, will afford more relief than anything else, especially if the wound be made to suppurate abundantly.

Bony tumors, growths or deposits of this membrane are to be treated upon the same principles as exostoses, properly so termed. When small, not painful, or not inconveniently situated, they will probably require no attention. Occasionally they disappear spontaneously, or under the influence of very simple remedies. Such formations are nearly always caused by the effects of the gouty, rheumatic, or syphilitic poison, and are, therefore, generally greatly benefited by iodide of potassium and a mild course of mercury.

Finally, the periosteum is sometimes the seat of the heterologous formations, as the melanotic and tubercular. In carcinoma of the bones, the membrane is now and then implicated secondarily, but is rarely, if ever, the primary seat of this malady. In a number of dissections which I have made of encephaloid disease of the bones and soft parts, I have found it entirely intact, not even thickened or indurated.

SECT. II.—ENDOSTEITIS OR OSTEOMYELITIS.

Under this name, one of recent introduction into surgical nomenclature, may be described a disease of the medullary membrane, now known as the endosteum, possessing all the characters of true inflammation. Faint traces of such an occurrence are to be found in several authors of the last century, but it is only within the last few years that special attention has been called to it, or that the subject has been studied in a scientific manner.

The *causes* of this affection, which may be either acute or chronic, and which can hardly, in any case, exist uncombined with more or less osteitis, are generally of a traumatic nature, consisting of fractures, gunshot wounds, the lodgment of foreign bodies in the substance of the bones, violent blows, contusions, concussion of the spongy tissue, and laceration of the endosteum by the saw in amputation of the limbs, of which the lesion is by no means an uncommon consequence, as is shown by the suppuration and necrosis which so often follow this operation. There can be little doubt that the inflammation is frequently produced by the mere concussion of the limbs, transmitting its injurious effects along the canals of the long bones, thereby, perhaps, partially detaching portions of the lining membrane, and so inducing serious disruption of the circulation. Cold is another cause of endosteitis, and there is reason to believe that many of the cases of necrosis of the shaft of the femur, tibia, and other long pieces of the skeleton, originate in this manner. Occasionally the malady depends upon some constitutional taint, as the syphilitic, strumous, or scorbutic, awaking inflammation consentaneously in the endosteum, osseous tissue, and periosteum.

The *morbid anatomy* of the disease is best studied in one of the long bones, as the femur or tibia, after amputation. If several days have elapsed since the operation, the membrane will be found to be of a pale pink hue, more or less injected, and apparently a little thickened, the marrow is abnormally soft, and the cells of the spongy structure of the canal are pervaded by a sero-sanguineous fluid. At a later period, when the inflammation is more fully established, the discoloration of the endosteum is of a more decided character, being of a deeper red with a shade of brown or purple, the fatty matter is broken up into a semi-liquid substance, and, in addition to the bloody sanies just alluded to, evident traces of pus are seen, forming numerous little points, of a yellowish aspect, which, gradually coalescing, at length assume the character of small abscesses. When the disease is uncommonly violent or protracted, portions of the endosteum are found to be converted into real eschars, of a brownish color, and of a characteristically fetid smell; the periosteum opposite the seat of the morbid action becomes detached, and the intervening portion of the bone, thus deprived of its vessels, speedily perishes.

In the chronic form of the disease, which sometimes lasts for years, the osseous structure is rendered abnormally hard, dense, and heavy, the medullary canal is in great measure, if not entirely, obliterated, and the endosteum at the seat of the morbid action is completely destroyed. Small cavities filled with a soft oily material, or fatty gelatinous substance, and surrounded by softened, vascular, reticulated tissue, are not unfrequently found; and cases are occasionally met with, although rarely, in which there are small abscesses and dead pieces of bone. When the disease is of long standing, the affected bone is generally more or less changed in its form, rough on the surface, and remarkably compact and heavy.

The *symptoms* of endosteitis are vague and unreliable, it being difficult, if not impossible, to distinguish them from those which attend inflammation of the bones and their fibrous envelop. Indeed, it is only when the disease occurs as the result of injury, as after amputation, that anything even like a plausible conjecture can be formed as to its real nature. Under such circumstances, upon taking off the first dressings, the wound opposite the end of the bone will probably be found to be gaping and filled with pus, the bone itself being either entirely denuded, or only slightly covered with lymph below, while the medullary membrane is of a reddish or brownish color, and more or less vascular. If six or eight days have elapsed since the operation, the exposed medullary surface will be likely to be studded with pale, flabby, unhealthy granulations, somewhat sensitive to the touch, or perhaps even quite painful, and discharging an abundance of thin, sero-sanguinolent fluid. Around this red and inflamed circle, the compact layer exhibits an unusually white, glistening appearance, without any trace of reparative action; in fact, the bone seems to be more dead than alive, or, if not actually dead, it will soon be. Superadded to these phenomena, there is occasionally a discharge of marrow, with or without fragments of the medullary membrane; a sure sign of the inflamed and disorganized state of the parts.

Endosteitis is always attended with considerable swelling and puffiness of the soft structures immediately over the affected parts, but there is not necessarily any discoloration of the surface, or any unusual pain. Considerable irritative fever is commonly present; the skin has a peculiar sallow hue; and there are apt to be rigors, alternating with flushes of heat, and followed by copious sweats, generally of a disagreeable acid nature. When the disease is idiopathic, there may be tumefaction and pain, deep-seated and throbbing, at the site of inflammation, but neither of them of so distinctive a character as to be of any service in a diagnostic point of view.

Endosteitis cannot be considered otherwise than as a dangerous malady; for, when severe or extensive, it is not only apt to cause extensive necrosis, but may destroy the patient by the induction of phlebitis in the principal veins of the corresponding limb, and abscesses in the different viscera, especially the lungs and liver. Occasionally, it would seem to be capable of assuming a sort of endemic tendency. Thus, in 1814, nearly all the patients at the Hôtel Dieu, in Paris, who died after amputation, and the number was quite considerable, were observed to have suppuration in the medullary membrane of the long bones.

The *treatment* of endosteitis must be conducted upon general antiphlogistic principles, local and constitutional, in the hope of limiting morbid action and preventing the occurrence of suppuration and gangrene. If the medullary canal be exposed, some mildly stimulating injection, such as a very weak solution of nitrate of silver, tannin, or acetate of zinc, may be useful, the part being protected from the atmosphere by lint wet with a similar fluid, or an emollient cataplasm. If the membrane be affected in its continuity, and there is much swelling of the soft structures, free incisions may be necessary in order to relieve tension and promote the escape of effused fluids; and if there be reason to apprehend the existence of medullary abscess, as there will be if there be deep-seated, aching, gnawing, or boring pain, with œdema of the subcutaneous cellular tissue, the surgeon must not hesitate to cut down upon the matter with the crown of a small trephine as the only chance of averting still more serious consequences.

In the strictly chronic form of the disease, the chief reliance of the surgeon is upon iodide of iron and potassium, with minute doses of bichloride of mercury, tonics, cod-liver oil, change of air, and counter-irritation. In the more hopeless cases, it may be necessary to trephine the affected bone, or even to resort to amputation.

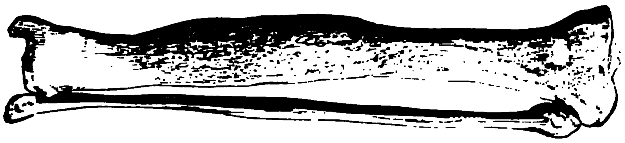
SECT. III.—OSTEITIS.

Osteitis, or inflammation of bone, at one time regarded as uncommon, is, on the contrary, of frequent occurrence, especially in early life, owing, doubtless, to the great vascularity of the osseous tissue at that period rendering it more susceptible of disease than in old age, when many of the vessels shrink and disappear. The lesion may be primitive or consecutive, acute or chronic; and in either case it may be limited to a particular portion of a bone, or pervade its entire length and breadth, although this is unusual. The spongy tissue suffers more frequently than the compact, a circumstance which is apparently due to the greater vascularity of the former than of the latter; and what is particularly remarkable is that in the first the disease often passes into ulceration, while in the latter it more frequently causes necrosis, or mortification, the two structures being evidently endowed with different powers of resisting the effects of inflammation. The pieces most liable to be affected are those which are naturally the least covered by soft substance, as the tibia, fibula, ulna, clavicle, and frontal bone. The disease is generally slow in its progress, and hence a considerable period may elapse before there is any very appreciable alteration of tissue. Cases, however, occur, where it proceeds with immense and overwhelming rapidity, suppuration, ulceration, and even mortification appearing in less than forty-eight hours from the commencement of the attack.

If a bone laboring under inflammation be carefully examined, it will be found to exhibit several important structural changes of great interest. At first it is simply enlarged, although less so than is usually imagined, because much of what appears to be enlargement is due rather to swelling of the periosteum, which is nearly always present under such circumstances, than to any actual expansion of the osseous tissue itself. Gradually the affected bone loses its density, becoming softened, and infiltrated with a sanguinolent fluid, of a sero-plastic nature, and assuming a bright reddish hue, the capillaries being very numerous, turgid, and distinct. As the disease advances, the osseous fibres separate from each other, and the widened intervals are immediately filled with inflammatory deposits, often intermingled with little clots of pure blood. These alterations are always attended by an absorption of earthy matter, which has the effect of rendering the bone both soft and spongy, at the same time that it causes an actual diminution of its weight. The lamellæ of the compact substance are resolved, as it were, into their primitive distinctness, the Haversian canals are greatly enlarged, and the cells of the areolar texture are remarkably rarefied. When the disease has reached its maximum, the bony tissue is frequently so soft as to admit of being bent and cut with considerable facility. When the inflammation is superficial, affecting the outer layers of a bone, it always promptly extends to the periosteum, which, in consequence, becomes hot, red, and swollen, its substance being infiltrated with serous and plastic effusion. If, on the other hand, the inner structure is involved, the endosteum is sure to suffer, assuming a discolored, bloodshot appearance, while the adipose matter is either rapidly absorbed, or converted into a soft diffluent mass, of a light reddish hue, and of a peculiarly fetid character. When the inflammation of the bone is at all extensive, both periosteum and endosteum participate in the morbid action, and it is in these cases, more especially, that, the circulation being cut off by fibrinous exudations, necrosis is so liable to arise.

Osteitis may terminate in resolution, the morbid phenomena gradually disappearing, and the affected structures regaining their primitive texture; or the disease may cease, and the bone become indurated and enlarged in consequence of interstitial osseous deposits; or, lastly, the inflammation may pass into suppuration, ulceration, softening, or mortification, the results resembling those of inflammation of the soft parts. It is seldom that a bone, after having been inflamed for any length of time, will not, upon recovery, remain somewhat hypertrophied, or larger and harder than it was before the attack, as seen in fig. 280. It is, in fact, nature's mode of cure, the process which she employs for repairing the mischief committed by the disease.

Fig. 280.



Hypertrophy of the tibia from inflammation.

Causes.—The causes of osteitis are either traumatic or constitutional, the former consisting of injuries inflicted in surgical operations, fractures, contusions, and wounds, especially gunshot and punctured, and the latter of a syphilitic, strumous, scorbutic, rheumatic, or gouty taint of the system, together with the operation of cold. The disease may begin directly in the osseous tissue, or this may be involved secondarily, in consequence of the extension of the disease from the surrounding parts. Thus, in dislocations, particularly compound, and also in simple dislocations of the larger hinge-joints, as the elbow and knee, the inflammation consequent upon the accident is nearly always communicated to the contiguous extremities of the bones, rendering them soft and brittle, and liable to give way under slight influences. In like manner the periosteum often becomes the propagator of the morbid action; for, although, in general, this membrane serves to ward off disease, forming a kind of wall between the soft structures and the bones, yet this barrier is not unfrequently overleaped, and inflammation kindled up in the very centre of these pieces. A great similarity is thus found to exist between the bones, periosteum, and endosteum, on the one hand, and the lungs, pleura, and bronchial mucous membrane on the other, experience having proved that disease cannot be present in any considerable degree, or for any length of time, in any one of these component elements without being propagated to the rest, which subsequently have often to bear the chief brunt of the incited action.

Symptoms.—The symptoms of osteitis bear a great resemblance to those of periostitis and endosteitis, and hence the most adroit diagnostician often finds it difficult to discriminate correctly between them. Practically, an error of this kind is of no special moment, as the treatment is essentially similar in the three affections, but as a matter of science it would certainly be desirable in every instance to ascertain, if possible, in what structure the disease is located, or, if all are implicated, in what degree. There is really, however, no one symptom, or group of phenomena, upon which the least reliance can be placed as a means of discrimination. It may be said that the pain in osteitis is more intense, agonizing, and deep-seated, than in inflammation of the periosteum and endosteum, and yet this is true only as a general rule; in the great majority of cases the difference is too slight to be appreciable. The same is true in regard to the swelling of the soft parts, and the constitutional disorder, which are often considerable in all these affections, but as they do not possess any distinctive features, are of no value in a diagnostic point of view.

Acute inflammation of bone is generally attended by the same symptoms as acute inflammation of the soft structures. The pain is excruciating, the part feeling as if it were torn, or bored, or as if insects were feeding upon it; it is deep-seated, more or less circumscribed, and increased by motion, pressure, and damp states of the atmosphere; it is also usually more violent at night when the patient becomes warm in bed, especially when it recognizes a constitutional origin. The swelling is extensive, firm, and almost inelastic, pitting, perhaps, after a time, under the application of the finger; the skin has a glossy, shining appearance; and there is intense heat of the surface, conjoined, in most cases, with an erysipelatous blush. The constitution sympathizing powerfully with the local disorder, there is high fever, with excessive thirst, a full, bounding pulse, and great dryness of skin, with all the minor phenomena of general incited action. If the disease be not promptly restrained by appropriate antiphlogistic measures, the soft parts suppurate, the event being announced by rigors and delirium, followed by copious sweats.

Acute osteitis is seldom dangerous to life, but may prove fatal if it be extensive, or complicated with other maladies, by the induction of erysipelas, pyemia, or constitutional irritation. Such an event will be most likely to happen in young scrofulous subjects, or in persons worn out by the effects of syphilis. The malady often terminates in serious and irremediable structural disease of the affected part, as softening, caries, and necrosis, requiring important operations, which are themselves frequently a source of much risk. Recovery, in any event, is generally extremely tedious.

The symptoms of *chronic osteitis* are such, in general terms, as characterize chronic inflammation of the soft structures. The bone is the seat of more or less pain, circumscribed, increased by motion and pressure, and usually aggravated at night, often depriving the patient of sleep and appetite. Enlargement of the affected part, with swelling and induration of the overlying tissues, is commonly a prominent phenomenon. Sooner or later suppuration occurs, followed by the formation of sinuses, difficult to heal, and the seat of a constant discharge of thin, ichorous, sanious, or unhealthy matter, occasionally mixed with osseous particles. The constitution frequently sympathizes with the local disorder, as indicated by the pallor of the countenance, the gradual emaciation, and other evidences of failing power.

Treatment.—The treatment of osteitis must be conducted upon general antiphlogistic principles, of which bleeding, if the patient be at all robust, tartar emetic, purgatives, calomel, and opium, with perfect rest both of the part and body, constitute most essential elements. The prompt abstraction of blood by the lancet, or by leeches from the affected structures, will generally prove of marked benefit in cutting short the disease, or, rather, in limiting the sphere of its action. Calomel should be given as soon as the patient has been well bled and purged, and should be steadily continued until gentle ptyalism has been provoked. There is no remedy which, after proper depletion has been premised, exerts so powerful and controlling an influence over inflammation of bone as this; and, although it should not be used causelessly, or without due precaution, there are few cases to which it is not applicable. To prevent it from running off by the bowels, and, at the same time, to mitigate the excessive general and local distress, it should be administered in combination with large doses of opium, repeated as frequently as the exigencies of the case may seem to require.

The best local remedies, besides leeches, are hot anodyne fomentations, light medicated cataplasms, dilute tincture of iodine, and blisters, the latter being applied in such a manner as to cover in the whole of the affected surface, and allowed to remain on until thorough vesication has been produced. If matter form, or even if there be merely great tension, the knife must be used, the incisions being long and deep, extending down to the very substance of the bone. Without such an expedient relief is impossible. If the pus be allowed to accumulate, it will be sure to burrow, insinuating itself freely among the muscles, and perhaps even between the periosteum and bone, thereby detaching these parts from each other, and thus inducing extensive necrosis. What is done for the soft tissues, under such circumstances, should be done also for the affected bone, although practitioners are generally agreed to let it take care of itself. Is this good practice? The surgeon makes it a rule in inflammation of the soft structures to relieve pain and swelling by early and free incisions, and he finds that the procedure is usually followed by the most happy results, texture being saved and much suffering avoided. Why should he not adopt a similar treatment in osteitis attended with swelling and excruciating torture in consequence of effused fluids? Several openings might be very easily made into the affected bone with the crown of a very small trephine, the soft tissues being carefully divided as a preliminary measure. The operation never fails to be beneficial, and there is reason to believe, from what I have seen of it in my own practice, that if it were more frequently resorted to than it is there would be much fewer cases of necrosis and caries than are now seen to follow this disease.

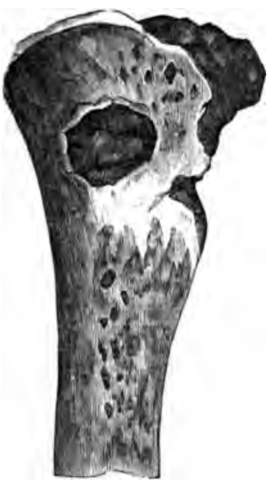
In chronic osteitis our chief dependence is upon alterants, purgatives, and counter-irritation, of which the best form is an issue made with the hot iron as near as possible to the seat of the disease. A free discharge should be established and steadily maintained until the morbid action is effectually broken up. The most reliable alterant is iodide of potassium in union with bichloride of mercury, carried, in obstinate cases, to gentle and somewhat persistent ptyalism. Such a course is particularly indicated in syphilitic osteitis, but is hardly less beneficial in the rheumatic, gouty, and strumous forms of the malady.

SECT. IV.—SUPPURATION AND ABSCESS.

Suppuration of the external surface of bone is a very common occurrence, and may arise from various causes, as fracture and other external injury, or a syphilitic taint of the system. As the morbid action, however, which precedes and accompanies the suppuration, is usually associated with inflammation of the periosteum, it is difficult, in most cases, to determine which structure is really the source of the purulent matter. When the osteitis is of long standing, or characterized by inordinate severity, the pus is occasionally diffused through the proper substance of the bone, but such an occurrence can only happen in the event of the osseous tissue having undergone previous softening, the removal of the earthy matter being followed by the formation of cells or cavities for the lodgment of the fluid. If a vertical section be made of a long bone, as the tibia, in an advanced state of inflammation, it will be found that the pus, presenting itself in small globules, will be scattered both through the Haversian canals and the cells of the areolar substance, no disposition being manifested in the little depôts to arrange themselves into abscesses. The intermediate structure is of a reddish color, filled with fibrinous exudation, and so soft as to be easily divided with the knife. This punctiform variety of suppuration is seldom so conspicuous as in inflammation of bone complicated with endosteitis.

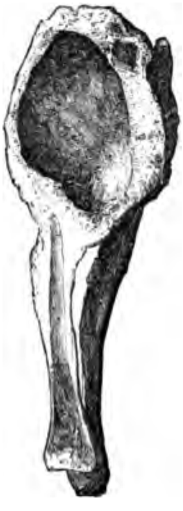
Abscess of bone, distinct, circumscribed and well-defined, such as we see in phlegmonous suppuration of the soft parts, and as is represented in fig. 281, is an occurrence of extreme rarity. The formation takes place slowly, an unusual degree of chronicity being one of the natural concomitants of the disease. The most common seat of abscess is the head of the tibia, or the head and lower extremity of that bone, the expanded and rarefied tissue of which is peculiarly well adapted to such an occurrence. The abscess ranges in size from that of a pea to that of a pigeon's egg; is generally solitary; is lined by a thin though distinct membrane; and is occupied by a dark-colored, ill-elaborated pus, more or less fetid, and intermingled with aplastic matter or curdy flakes similar to those observed in strumous pus. The surrounding tissues are softened, congested, and infiltrated with sero-sanguinolent fluid. The manner in which the abscess terminates is variable; when seated near the extremity of a bone, it sometimes manifests a disposition to discharge its contents into the contiguous joint; at other times, and more generally, it maintains its position, becoming as it were encysted by the deposition of new bone around

Fig. 281.



Abscess in bone.

Fig. 282.



Large chronic abscess of the tibia, the bone being much thickened as well as expanded round the cavity.

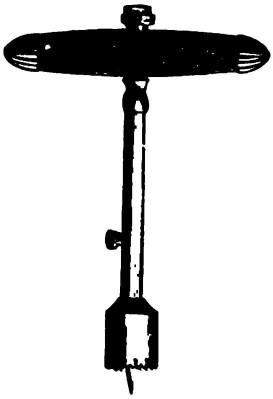
it, as delineated in fig. 282. Finally, in a third class of cases, the matter continues to accumulate, apparently for a long time, and pressing upon the osseous tissue in every direction, gradually expands the bone into a large shell, capable of holding several ounces, and so thin and soft as to be bent and cut like cartilage.

The *symptoms* denotive of the formation of pus are usually such as characterize this event in the other tissues, only that the local suffering is generally more intense, especially if the matter has no free vent. The existence of abscess in the interior of a bone is indicated by a dull, gnawing, heavy pain, circumscribed, deep-seated, remittent, and more like a violent toothache than anything else to which it can be compared. In many cases it is of a throbbing, boring, tearing, or lancinating nature. It is always worse at night than in the day, and is usually so intense and exhausting as to make serious inroads upon the general health, the patient soon becoming wan and sallow, and affected with hectic irritation. Occasionally the pain completely intermits, the parts being wholly free from suffering for many hours, and even days together; more generally, however, it is continued with partial remissions. The soft structures, at the seat of the abscess, are always exquisitely tender, especially at one particular spot directly over the matter, more or less tumefied, glazed, and œdematous, often pitting on pressure. The formation of matter is generally announced by rigors, alternating with flushes of heat, and similar attacks are very common during the progress of the disease, particularly in the early part of the night, the body being usually drenched under such circumstances, towards morning, with acid, offensive perspiration.

Although the symptoms of abscess are in general well marked, yet, as they are liable to be simulated by other affections, they cannot be said, in the true sense of the term, to be characteristic. The principal affections with which they are liable to be confounded are necrosis and deposits of new bony matter, compressing and irritating the parts so as to keep up intense pain and tenderness, similar to what is produced by collections of pus in the soft structures. Fortunately, accuracy of diagnosis is of little consequence in these cases, as the treatment is essentially the same, whether the symptoms arise from abscess, the lodgment of dead bone, or interstitial osseous deposits. The discrimination between abscess and neuralgia, which often closely imitate each other, is of more importance, on account of the difference of treatment, but so far as I know there are no diagnostic signs by which the distinction can be effected.

Abscess of the osseous tissue admits of relief only in one way, and that is by efficient evacuation with the trephine, for in no other manner can the pent-up fluid be reached. The operation is not always as easy as might at first be imagined, owing to the excessive firmness of the affected bone, in consequence of interstitial deposits, which often give it the closeness and density of ivory. The best instrument is a common cranium-trephine, with a caliber from three to four lines in diameter, with sharp, well set teeth, and fluted at the surface, so as to make a wide track. If any difficulty is apprehended on account of the extraordinary hardness of the bone, it will be proper to have two saws, of precisely the same size, in order that there may be no delay in the operation in the event of an accident. The surgeon, taking the site of pain and swelling, or the "tender spot," as his guide to the seat of the abscess, exposes the bone by a free incision, either single, T like, or crucial, as may be deemed necessary, and then turning aside a small portion of periosteum, applies the trephine, fig. 283, the centre-pin being protruded until the instrument has made for itself an adequate groove. The arrival of the saw in the abscess is generally denoted by a sudden cessation of resistance, and by the escape perhaps of a few drops of pus mingled with blood. If no matter be found after sinking the instrument to a considerable depth, it is applied at some other point, in the vicinity of the former, in the hope of a more successful result, for it is often quite impossible, in these cases, to hit the precise spot where the matter is located in a first or even a second attempt; on the other hand, however, care must be taken not to make too many perforations, lest the bone be thereby unduly weakened or suffer other injury. Moreover, it is not to be inferred by any means, that, although no pus has been detected, the operation will, therefore, be a failure; perhaps the instrument may have come in contact with a small sequester, lying loose in the cellular tissue of the articular extremity of the bone, and by removing this, rapid recovery may take place; or, instead of this, the pain and other symptoms may have been occasioned by the pressure of interstitial deposits, and the excision of a disk of bone may afford relief on the principle of taking off tension, as a free incision does in deep-seated purulent collections in the soft structures.

Fig. 283.



Trephine.

The abscess having been opened, its cavity is washed out with the syringe, as much to get rid of the sawdust as to clear away pus and stimulate the pyogenic sac; a narrow tent is then inserted into the bottom of the opening, and the wound gently supported with adhesive strips, the after-treatment being conducted upon strictly antiphlogistic principles. The relief from the operation is often immediate, and there is no class of cases in which the efforts of the surgeon are generally rewarded with more unalloyed satisfaction. The patient, tortured for months with pain and sleepless nights, is suddenly translated from torment into Elysium.

SECT. V.—CARIES OR ULCERATION.

Caries is a disease of the osseous tissue, strictly analogous to ulceration of the soft parts. It is essentially of an inflammatory type, and is characterized by an increase of vascularity, softening, and disintegration, the earthy matter being separated from the animal, and eliminated along with the discharges, which are often quite profuse, especially when the malady has made considerable progress. Caries differs from ordinary osteitis chiefly in this, that it is attended with actual loss of substance, the affected tissue being gradually broken down, excavated, or destroyed, whereas, in the latter, it retains its different elements, although in an altered condition, the principal changes consisting in congestion, softening, and sero-plastic infiltration. There are other points of difference, as the seat of the two diseases, the age at which they respectively occur, and the nature of the concomitant secretions, which will be rendered evident by a careful study of the subject.

Caries is most liable to occur in those pieces of the skeleton which are distinguished by the abundance of their areolar tissue. Hence it is most common in the vertebræ, the sternum, the innominate bones, the bones of the carpus and tarsus, and the articular ends of the long bones, especially of the femur, tibia, and humerus. The compact tissue is more frequently the seat of necrosis than of caries; indeed, the affection cannot occur here unless this tissue has previously undergone a certain degree of softening, so as to prepare it, as it were, for the disintegrating process which characterizes it.

Young persons are most subject to caries, particularly children under ten years of age; it is seldom that it is met with even so late as middle life, and then chiefly as a result of some specific taint of the system, more especially the syphilitic. I am not aware that sex exerts any material influence upon its production, for I think it has occurred in my own practice with nearly equal frequency in males and females. Temperament and occupation may predispose to it, but if this be so we have no positive proof of the fact. Strumous children are particularly obnoxious to caries, and this circumstance, of which daily observation furnishes abundant evidence, long since created a doubt in my mind whether the disease is not really, in a great majority of cases, of a tubercular nature. The further I examine the subject, the more I am satisfied of the truth of this opinion. Most of the children that are brought to me with this disease, as it occurs in the spine, the hand, foot, and ends of the long bones, present all the characteristic features of the scrofulous diathesis; and I am quite sure that this experience, instead of being peculiar to myself, must be common to all practitioners. I do not, therefore, throw out this view as a mere conjecture, but as a conviction, and shall speak of it hereafter as the basis of important therapeutic indications.

Causes.—The causes of caries are of two kinds, local and constitutional, of which the latter are by far the more common and influential. As appertaining to the first, are various injuries, as blows, kicks, falls, fractures, contusions, and concussions, disturbing the circulation and innervation of the osseous tissue, or depriving it of its fibrous covering, and thus modifying its nutritive action. In the bones of the foot, especially those of the tarsus, the disease is sometimes induced by the penetration of a foreign body, as a nail, or splinter of wood. The sawing of the bones in amputation and resection, and their accidental division by sharp instruments, is occasionally followed by caries, both extensive and protracted. Cases occur where the disease is produced by the pressure of an aneurismal tumor, and by the application of escharotic substances.

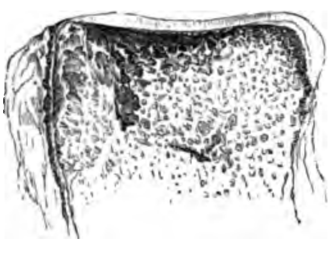
Among the internal causes of caries may be cited whatever has a tendency to induce general debility, or to impoverish the fluids and solids, and, consequently, to exhaust the innervation. Hence we may place at the head of the list severe and protracted courses of mercury, the operation of the syphilitic poison, a gouty or rheumatic state of the system, scurvy, scrofula, profuse loss of blood, and severe attacks of dysentery, diarrhœa, typhoid fever, and eruptive diseases, as scarlatina, measles, and smallpox. All these circumstances are, as is well known, capable of producing ulceration both in the skeleton and the soft parts, as is proved by the numerous sores which so often arise in different regions of the body, as the sequelæ of these affections, and which we usually find so difficult of cure.

Of all the internal causes, however, of caries, there is none which, in my opinion, exercises so powerful an influence in the production of this disease as scrofula. In making this remark, I do not mean to say that there is always, under such circumstances, a deposit of tubercular matter; on the contrary, I am satisfied that there is, in most cases, merely a tubercular diathesis, predisposing the part to the disease, and thus rendering it less capable of resisting its effects when once it is established. As in strumous ophthalmia there is often serious disease, and yet no evidence whatever of tubercular deposit, so in strumous caries a bone may be completely softened and disintegrated, without any secretion of strumous matter, properly so termed. In both cases the diathesis exists, but not the tubercular matter. As this is the most frequent cause of caries, so is this form of the affection also one of the most difficult to remove.

Morbid Anatomy.—If a carious bone be subjected to careful examination, it will be found to exhibit marked differences in its appearances, according to the duration of the disease and the nature of the affected piece. In the earlier stages, the osseous tissue is merely inflamed, as is evinced by its vascular and softened condition; its spongy texture is rarefied, and occupied by a serous, oily fluid, intermixed with a good deal of the coloring matter of the blood, thus giving it a reddish aspect. It can be cut with the knife, or even indented with the finger, especially if the bone be a carpal or tarsal one, and, upon macerating it, the water soon becomes covered with a layer of fatty matter. Exposed to the air, it dries with difficulty, and assumes a pale, yellowish hue, verging slightly upon greenish. When the disease has reached its more confirmed stages, the bone is found to be excavated, or riddled with cavities, of variable size and shape, sometimes lined by a kind of pyogenic membrane, and filled with thin, sanious, and offensive matter, having none of the characteristic properties of laudable pus. Occasionally small fragments of bone lie loose in these cavities, being unable to escape on account of their disproportionate dimensions to the size of the opening in the surface of the affected piece. The osseous tissue is now extremely soft and brittle, breaking down readily under the finger; it is still more porous than before, and is of a grayish, brownish, or blackish color. It is apparently destitute of vessels, and gives out a considerable quantity of oily or greasy matter on maceration, the fat floating on the surface of the fluid. In many instances, however, the quantity of fat is very small, and the bone has rather a dryish than an unctuous appearance. In a chemical point of view, the only notable difference between carious and healthy bone is the greater amount of cartilage and fat in the former than in the latter, the quantity of cartilage often forming as much as thirty-seven per cent., while the amount of fat is upwards of three. This quantity of fat, although much greater than what exists in the normal state, is not sufficient to justify the opinion expressed by some that caries essentially consists in adipose degeneration of the osseous tissue.

The osseous tissue immediately around the softened and disintegrated structure is always more or less inflamed, being preternaturally red and vascular; the periosteum is thickened, spongy, and injected; and the endosteum exhibits all the phenomena of an active participation in the disease. The compact lamella has often a worm-eaten appearance, and it is not uncommon to find it partially incrusted with bony matter. The soft parts around are infiltrated with sero-plastic matter, indurated, closely matted together, and otherwise altered. In articular caries, there is always more or less involvement of the cartilages, which are gradually softened and disintegrated, as in fig. 284, large pieces often coming away with the discharges.

Fig. 284.



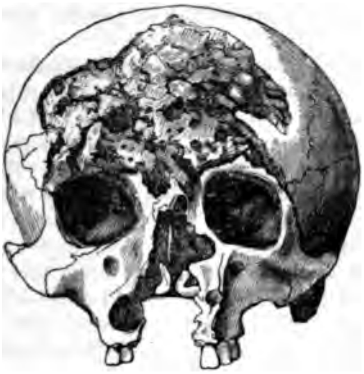
Caries of the astragalus, with softening and incipient separation of the cartilage.

The ravages of caries of the osseous tissue, consequent upon the effects of tertiary syphilis, are well displayed in fig. 285. The disease commenced in the soft palate, from which it gradually extended to the bones of the cranium and face, causing a free communication between the mouth, nose, orbits, and frontal sinuses. Fig. 286, from a specimen in my collection, affords a good illustration of caries of the head of a bone.

Symptoms.—The symptoms of caries are usually obscure, especially in its earlier stages, the line of demarcation between it and osteitis being impossible to be determined. It is only when the affection has terminated in suppuration, ulceration of the soft parts, as in fig. 287, or the formation of sinuses, that its real character can be fully made out. Prior to this the surgeon may suspect the nature of the disorder, but he cannot by any means be certain of it. All the symptoms, in the first instance, are those simply of osteitis.

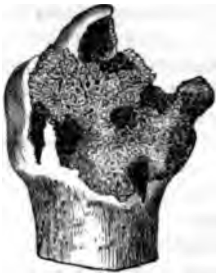
There is a dull, heavy, aching pain, which appears to be deeply seated in the substance of the bone, and which gradually increases in extent and severity with the progress of the morbid action; the part feels exquisitely tender to the touch; the skin has a glazed, reddish appearance, and there is marked tumefaction, which, though somewhat diffused in its character, is generally particularly distinct at the focus of the inflammation. The local phenomena gradually augment in intensity, the pain assumes a throbbing disposition, the swelling becomes more pointed, and presently the loose, flabby integuments give way by ulcerative action, thus allowing the contents of the abscess—for such in fact the case now is—to drain off. The bone thus laid bare exhibits a foul and corroded aspect, at the same time that it feels soft and rough to the finger. If the examination be conducted with the probe, as it must be when the bone is deep-seated, the instrument will be found to pass very readily into its substance, which is already softened and partially disintegrated, a short time being generally sufficient to effect important changes.

Fig. 285.



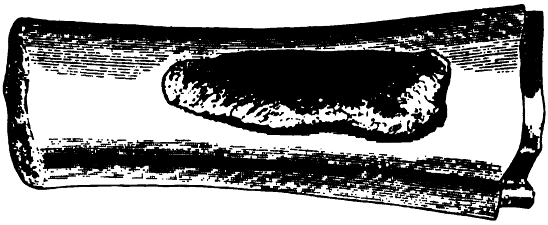
Syphilitic caries of the skull.

Fig. 286.



Caries of the head of the humerus.

Fig. 287.



Caries of the tibia, with an ulcer in the skin.

The *sinuses* leading to the seat of the disease are either straight or tortuous, and vary in length from a few lines to several inches, according to the depth of the affected bone, and, above all, the place of opening of the resulting abscess. In general they are multiple, most of them opening by separate orifices, so as to give the surface a cribriform appearance. In chronic cases the sinuses are lined by a species of false membrane, and the situation of each is indicated by a mass of reddish granulations, somewhat mammillated in shape, in the centre of which the aperture of communication is generally easily detected with the point of the probe. This nipple-like body, which is often entirely insensible, and almost always smeared over with pus, projects considerably above the surrounding level, and is of great diagnostic value, as it is invariably denotive of carious or necrosed bone. The sinuses here described do not commonly all form at once; perhaps there may be only one or two at the beginning, the rest being superadded during the progress of the disease, or, perhaps, as one closes another appears. Whatever may be their mode of development, the parts around are more or less indurated, inflamed, and tender on pressure.

The *discharge* furnished by the affected bone is extremely variable; in general, however, it is of a thin, ichorous, sanious, or bloody character, loaded with earthy matter, extremely fetid, and so irritating as to erode the parts with which it comes in contact. It usually tarnishes silver—a circumstance which shows that it contains sulphuretted hydrogen gas—and is often so profuse as to cause serious exhaustion. The earthy matter is easily detected by its gritty character, by rubbing the fluid in while it is suspended between the thumb and finger, and frequently amounts to two per cent. of the entire discharge. Sometimes the pus is of a laudable nature, but when this is the case it may be assumed, as a general rule, that it is furnished by the adjacent soft parts rather than by the bone itself. Whatever its character may be, it is not uncommon for it to contain flakes of lymph, *débris* of cellular and aponeurotic substance, and even considerable fragments of bone and cartilage; the latter being most apt to show themselves when the sinus penetrates a neighboring joint.

The *constitutional* disturbance is not always proportionate, so far as we can judge, to the amount of the local disorganization. The general health is often but little affected, especially in the early stages of the disease; by degrees, however, it begins to give way, and ultimately it always suffers severely, the patient losing flesh and strength, the countenance becoming wan and pallid, and the sleep and appetite being destroyed. If the disease is at all extensive, or if, even when it occupies but a small compass, it opens into a large joint, as, for example, the knee, hectic irritation soon sets in, and, making rapid inroads upon the system, speedily reduces the patient to the very verge of the grave. The pain is often excruciating, particularly at night and in damp states of the atmosphere, and is one of the principal sources of exhaustion.

Diagnosis.—The diagnosis of caries can only, in general, be determined by a careful consideration of the history of each individual case. Until ulceration of the soft parts occurs, the nature of the disease must almost necessarily remain an enigma. The only affection with which it is liable to be confounded is necrosis, from which it may generally be easily distinguished, before the skin has given way, by the comparatively small amount of pain attending it, as well as by the lesser degree of constitutional disturbance, and by the fact that caries is usually met with in the short bones, while necrosis mostly occurs in the shafts of the long ones. When sinuses have formed, the eye, finger, and probe will usually be able to determine the diagnosis, by the appearance and feel of the affected structure. In both cases the bone is roughened, but usually much more so in necrosis than in caries; in the former it always retains its original consistence, whereas in caries it is so much softened as to be readily penetrated by the probe. Nothing of a definite character can be learned from the nature of the discharge, since it is nearly identical in the two maladies. Occasionally valuable information may be obtained from a consideration of the exciting cause. Thus, osteitis from syphilis terminates more frequently in necrosis than in caries, the reverse being the case when the inflammation is dependent upon a scorbutic or strumous taint of the system. To this statement, however, numerous exceptions occur, and the diagnosis must, therefore, at least in most cases, be a matter of time and of repeated critical examinations.

Prognosis.—The prognosis of caries is generally unfavorable, a spontaneous cure, although not impossible, being an extremely uncommon occurrence. When the disease is of limited extent, a cure may often be promptly effected by operative measures directed against the affected parts, but under opposite circumstances nothing short of resection or amputation holds out the slightest prospect of relief. In many cases the affection continues for years, apparently neither advancing nor materially receding, the general health in the meantime experiencing but little change; on the other hand, however, its progress is sometimes very rapid, and the constitutional disturbance proportionately great, hectic irritation, loss of strength, and emaciation setting in early, and steadily proceeding until the patient dies completely exhausted. As a general rule, it may be stated that caries is less likely to terminate favorably when it assails the vertebræ and the articular ends of the long bones than when it appears in any other portions of the skeleton, except, perhaps, the carpal and tarsal bones, in which the malady is often so extremely obstinate as to require the removal of the limb in order to save life. The prognosis is, of course, other things being equal, more unfavorable in sickly and debilitated persons than in such as are healthy and robust at the time of the attack.

Treatment.—The treatment of caries, notwithstanding the modern lights of pathology and therapeutics, is extremely unsatisfactory, if not entirely empirical. That it should always, if possible, be conducted with strict reference to the nature of the exciting cause, whatever this may be, is a self-evident proposition. When the disease has been induced by a syphilitic, strumous, or scorbutic taint of the system, remedies calculated to meet these respective contingencies will of course promptly suggest themselves to the mind of the practitioner, as most likely to fulfil the particular indication of the case; but where no such affection is visible, and where, in fact, nothing whatever of an appreciable character exists, he must disregard all rules, and limit himself to the application of general principles. In all instances, whether the disease be owing to constitutional or local causes, great care should be taken to combat inflammation, by the observance of the most perfect rest, to give vent to effused fluids, and to remove any fragments of bone as soon as they are sufficiently detached to warrant such a procedure. Among the general means, a properly regulated diet is one of the most important; it should be perfectly plain and simple, but at the same time nutritious, so as to build up the system, and create a better state of the blood, which is generally so much at fault in caries of nearly all portions of the skeleton. Chalybeate tonics, quinine, nux vomica, and cod-liver oil are the most valuable internal remedies; aided, as occasion may seem to demand, by blue mass and alkalies, to modify and improve the secretions. Much purging must be avoided, as it would inevitably prove prejudicial by its debilitating effects. Exercise in the open air is often of great service, but to render it efficient care must be taken not to move or irritate the diseased bone while it is being employed. Salt bathing, followed by dry friction, will be of benefit in imparting tone and vigor to the cutaneous capillaries; and in many cases the general health is immensely improved by a residence at the sea-side.

In commencing the *local treatment*, the first object should be to allay the irritation of the soft parts by attention to rest and position, and by the application of leeches, fomentations, and poultices, or warm water-dressings, medicated with laudanum and acetate of lead. When there is much induration from plastic deposits, the skin should be freely painted twice a day with the dilute tincture of iodine, and if the case prove obstinate a large blister should be used, experience having shown that, in superficial caries, this is more effectual in arresting the inflammation and bringing on the suppurative crisis than any other remedy. Even in deep-seated caries it frequently answers an excellent purpose, promptly arresting the excessive pain, and promoting the absorption of effused fluids. As soon as evident fluctuation exists, or even before, if there be inordinate tension and throbbing, a free incision should be made, extending, if possible, into the very depths of the bone, so as to admit of the most thorough drainage. To allow the matter to be pent up for days and even weeks, as often happens in the hands of timid practitioners, must always prove excessively injurious, from the tendency which the fluid, under such circumstances, has to burrow among the surrounding structures, detaching them from each other, and leading, in the end, to the formation of numerous sinuses. Besides, the early evacuation of the matter greatly abridges the suffering, constitutional as well as local, and thus prepares the system better for the future struggle. I have never seen a case where the retention of pus, whether among the soft parts, in the osseous tissue, or within a joint, has been productive of benefit; it always acts as a foreign substance, maintaining local and constitutional irritation, and hence I never hesitate to get rid of it as promptly and effectually as possible. These remarks are applicable to caries both of the superficial and deep-seated pieces of the skeleton. When the matter is pent up in the interior of a bone, as, for instance, in the articular end of the femur or tibia, evacuation should be attempted with the trephine.

The means now described are all merely of a palliative nature; they relieve pain, swelling, and constitutional disturbance, but are entirely incapable of curing the disease, however slight. To fulfil this indication other remedies are necessary, and these may be arranged under two heads, those, namely, which are used with a view of modifying the affected tissues, so as to afford them an opportunity of regaining their normal characters, and those which are resorted to for effecting riddance of the diseased bone, either in part or in whole.

Under the first of these heads are to be mentioned various *detergent* and acidulated preparations, as the solutions of the chlorides, creasote, nitrate of silver, and acetic, nitric, and hydrochloric acid, their strength varying with the age and constitution of the patient, and the state of the parts, the contact being effected by means of a large glass syringe, two operations being sufficient in the twenty-four hours. The chlorides are particularly serviceable in these cases on account of their cleansing and deodorant effects, while the acids act more directly upon the osseous tissue, stimulating the capillary and absorbent vessels, and thereby promoting a more healthy tone, at the same time that they produce disintegration of the earthy matter of the diseased bone. These remedies, and all others of a kindred nature, are certainly not without some benefit in the milder and more accessible cases of caries, but they all have the disadvantage of being difficult of application, as well as uncertain in their results, and can rarely be relied upon for a cure. I have, therefore, of late years, entirely abandoned their use with this intention, and now employ them only with a view to their detergent and deodorant effect, preferring, of course, the chlorides to any of the other articles for this purpose.

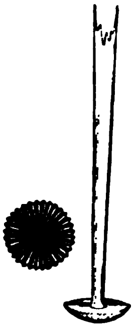
The *actual cautery*, formerly so much vaunted in the treatment of certain forms of caries, especially in that of the carpal and tarsal bones, is obnoxious to the same objections as the remedies just mentioned. In applying it, it is necessary not only to divest the affected bone pretty thoroughly of its soft parts, but to employ the greatest circumspection, otherwise a much larger amount of tissue may be destroyed than is desirable. Moreover, the eschar is always a long time in coming away, and the iron has generally to be used again and again before a cure is finally effected.

Under the second head are included the *operations* necessary for scraping or cutting away the diseased structure, excising the affected bone, either in part or in whole, and amputating the affected limb, when the case is unmanageable by other means.

As a general rule, all operative interference, having for its object the removal of the carious matter, is carefully abstained from until the disease has become strictly chronic, or, in some degree, ceased to spread. If this injunction be disregarded, injury, and not benefit, will be certain to follow our efforts, the irritation excited by them giving new impetus to the morbid action. The precise time for interference cannot, of course, be specified, but it is evident that no attempt should be made to scrape or cut the bone so long as the superimposed parts are in a highly tender, tumid, and inflamed condition. The proper treatment, under such circumstances, consists in the use of leeches, medicated fomentations, and other antiphlogistic measures calculated to soothe the irritated structures, and prevent the spread of the disease.

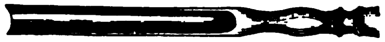
When the caries is of small extent, it may generally be got rid of by means of a burr-head drill, similar to that used by the dentist for removing caries from decayed teeth previously to plugging. With such an instrument, of which the adjoining sketch, fig. 288, affords a good idea, the whole of the diseased substance may often be cut away in a few minutes, with little pain to the patient, and no detriment whatever to the neighboring parts, which should always be turned aside immediately prior to the operation, care being taken in doing so not to interfere with any important structures. Every bone-case should have from three to six drills, of varying size and shape, so as to meet every contingency that may arise in practice. Several trephines, pliers, gouges, chisels, and scrapers, should also be at hand, and, when this is the case, it is difficult to conceive how any surgeon can fail in accomplishing his object. In operating upon the tarsal and carpal bones, I have generally derived material service from the use of a short, stout scalpel, with a semi-sharp convex extremity, and a large handle. Such an instrument is peculiarly advantageous in paring the surface of deep-seated cavities. When the ligaments and cartilages are involved, the operation can hardly be completed in a satisfactory manner without a pair of blunt-pointed scissors, with long, thick, narrow blades. The raspatory is useful in smoothing carious cavities after the removal of the disorganized substance. During the operation the diseased cavity is kept free from blood by means of sponge mops.

Fig. 288.



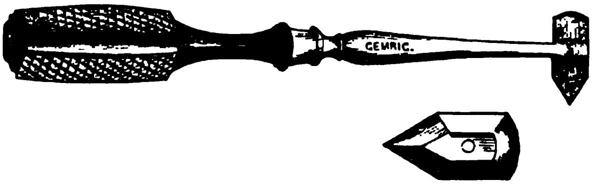
Bone-drill.

Fig. 289.



Gouge.

Fig. 290.



Scraper.

When all the diseased structure has been removed, free use should be made of the syringe in order to effect thorough clearance of the affected cavity. Unless this be done, more or less of the bony matter will be left, thus keeping up irritation and discharge, and interfering with the reparative process.

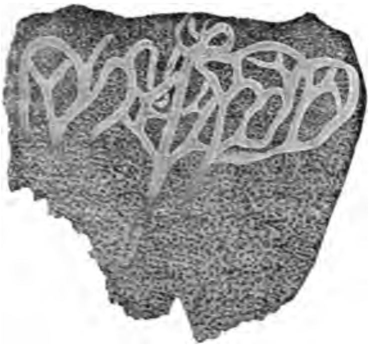
Considerable *hemorrhage* often attends these operations, the blood sometimes proceeding from small arteries, but more generally from numerous points, as if it came from the pores of a sponge. In the former case, the ligature will usually be required, more particularly as the vessels are unable to retract on account of the indurated condition of the surrounding parts, while in the latter the temporary application of the sponge, wrung out of cold water, will commonly speedily arrest the flow. Should this, however, not answer the purpose, the bleeding cavity should be stuffed with lint, soaked in a strong solution of alum, or of persulphate of iron, the plug being retained no longer than may be absolutely necessary.

Doubt is often experienced, in these operations, as to the amount of substance to be removed, the precise line of demarcation between the sound and diseased structures not being always easy of determination. A good diagnostic, under such circumstances, is to wash the fragments in water, when, if they be carious, they will exhibit a whitish, grayish, greenish, or blackish appearance; whereas, if they are healthy, they will be found to be vascular and red, and to retain their normal consistence, presenting none of the fragile and porous characters which distinguish them in the former case.

Bleeding having been arrested, the edges of the wound are loosely approximated by suture, and the limb, placed in a favorable position for drainage, is wrapped up in a bandage, extending from the distal extremity upwards beyond the seat of operation. Water-dressing is afterwards used, either cold or warm, as the case may seem to demand, and strict attention is given to antiphlogistics generally. Occasionally it is found requisite to insert a tent, to conduct off the matter, and prevent premature closure; and for some time the bony cavity should be injected twice or thrice daily with tepid water and Castile soap, or some gently detergent lotion. The great dangers after the operation are erysipelas and pyemia, which it is only necessary to mention in order to put the practitioner upon his guard respecting their occurrence.

The *healing process*, after such an operation, exhibits itself by the development of granulations, which, under the microscope, display very much the same appearance as those of the soft parts. The vessels, as shown in fig. 291, from a drawing made for me by Dr. Packard, have a remarkably looped and varicose arrangement. It was taken from an ulcerated patella, which was covered with an immense number of the most beautiful scarlet granulations, not as large as the smallest pin's head, closely grouped together, and exceedingly tolerant of rude manipulation. The section was magnified sixty diameters.

Fig. 291.



Structure of a granulation in a bone.

Excision of an entire bone is sometimes necessary for the relief of this disease. Such a procedure is most frequently required on account of caries of the carpal and tarsal bones, upon which it may frequently be performed with great advantage, a useful limb being generally left even after the removal of several of these pieces. In the long bones, the operation is usually limited to the articular end, or to this and a portion of the shaft. Respecting the manner of executing this operation, and the estimate to be placed upon it, in a curative point of view, special mention has been made in the chapter on excision, so that any further discussion of the subject here will be unnecessary.

When the disease is so extensive as to be uncontrollable by the means now described, and the attendant discharges are so copious as to give rise to profuse night-sweats, marasmus, and colliquative diarrhœa, *amputation* of the limb, comprising the carious bone, will afford the only chance of safety, and should be performed without delay. It is surprising how the system usually rallies after such an operation. The patient, in the course of a few days, generally looks like a new being; his sweats and diarrhœa soon leave him, and he rapidly improves in health and spirits, making often an excellent recovery.

SECT. VI.—NECROSIS OR MORTIFICATION.

The word necrosis denotes the death of a bone, and is strictly synonymous with mortification, gangrene, or sphacelus, used to designate the death of a soft structure. The immediate cause of the occurrence is inflammation, eventuating in an arrest of the circulation and innervation of the osseous tissue.

Necrosis is most common in those bones which are most superficial, or which lie immediately beneath the integuments, as the tibia, ulna, lower jaw, clavicle, the inferior portion of the femur, and the phalanges of the fingers. The long bones suffer more frequently than the short, and the short than the flat, the reverse being the case in caries, for the reason that, in the former, the compact tissue is most commonly affected, and in the latter, the spongy.

Children under fifteen years of age, particularly such as are of a strumous diathesis or habit of body, are the most common subjects of this disease. This is more especially true of the idiopathic form; for traumatic necrosis probably occurs as readily in adults and old persons as in young. Of the influence of sex, climate, and occupation, upon the production of the disease, nothing very satisfactory is known. If it be more common in boys than in girls, a circumstance, however, which has not been established, it is, probably, simply because the former are more exposed to the exciting causes of necrosis than the latter, and not because of any sexual peculiarity. It has been generally supposed, and not without reason, that the occurrence is most common in cold, damp, and variable regions; and the explanation of this seems to be that the inhabitants of these countries are particularly prone to suppression of the cutaneous perspiration, which, in individuals predisposed to disease, may, it is alleged, readily cause death of the more superficial bones. It has been ascertained that persons engaged in the manufacture of lucifer matches are liable to necrosis of the jaw, from the contact of the fumes of phosphorus with the interior of decayed teeth; and it is not improbable that there are other pursuits which may conduce to destructive inflammation of the osseous tissue, although of their precise nature and mode of action we are not informed.

Causes.—If we inquire into the idiopathic form of necrosis, we shall find, as has just been intimated, that it is most common in young strumous subjects, having well marked evidence of scrofula in other parts of the body, or, at all events, signs of a strumous predisposition, as evinced by the delicacy of the skin, the languid circulation, the tumid belly, and the deficient temperature of the extremities. I am certain that this has been the case in the great majority of the instances that have come under my own observation, and I believe that this, in the main, agrees with that of other writers. It is in persons of this description, more particularly, that we so frequently meet with the worst species of necrosis of the tibia, femur, and humerus, telling so fearfully upon the constitution, and so often requiring amputation in order to save the patient's life. The most common cause of the disease, in this class of subjects, is exposure to cold, as when a boy, overheated by play, sits down in a current of air, and thus suddenly repels his perspiration; or when, under similar circumstances, he strips himself, and plunges into cold water. He is not made aware, perhaps, for several days that he has received any injury; but, all of a sudden, he is seized with violent pain in one of his limbs, attended with severe rigors alternating with flushes of heat, and, upon examining the affected part, he observes that it is exquisitely tender on pressure, more or less swollen, and covered with an erysipelatous blush. The local and constitutional symptoms progressing, matter soon forms deep beneath the muscles, the swelling becomes more and more circumscribed, and, ulceration taking place, the contents of the abscess thus gradually find their way to the surface, leaving the bone dead below. Such is the manner in which necrosis is generally produced in weakly, scrofulous subjects, and it is hardly necessary to add that all the attendant phenomena are indicative of a rapidly destructive osteitis.

Tertiary syphilis is another cause of necrosis, and the history of this disease has shown that the osteitis growing out of it is more apt to occasion death of the bone when the patient has been subjected to free courses of mercury for its cure, than when the malady has been treated on general antiphlogistic principles. The two poisons coming together, and mingling their baneful influence, induce a form of ossific inflammation which is extremely prone, especially in persons of a worn-out, debilitated constitution, to terminate in gangrene of the bones—those of the nose, palate, upper jaw, leg, and arm in particular.

Protracted courses of mercury, especially in young subjects of a strumous diathesis, or exhausted by diarrhœa, cholera, or eruptive diseases, often cause necrosis of a frightful character, generally of the jaw-bones, but sometimes, also, of other pieces of the skeleton. What is termed dry salivation is frequently more destructive to the gums, teeth, and jaw-bones than salivation accompanied by profuse discharge. The debility produced by the injudicious use of drastic purgatives and tartar emetic has occasionally caused necrosis of the bones of the extremities, head, and trunk. Scurvy has been known to produce similar effects, although more commonly it causes caries. In short, there is reason to believe that idiopathic necrosis may be induced by whatever has a tendency to bring about an impoverished condition of the blood and solids.

Among the local causes of necrosis may be enumerated wounds, contusions, fractures, and chemical irritants; in the tibia, the probability is that mere concussion, as happens when a person falls from a considerable height and alights upon his foot, is often sufficient to produce a destructive form of osteitis. Gunshot injuries are a common source of the occurrence, whether the bone be merely grazed by the passage of the projectile, or whether the ball lodges in its substance and acts as a foreign body. Mere denudation of a bone, however occasioned, is frequently followed by its death, especially when the loss of periosteum is very considerable, or if, even when it is comparatively trivial, it is accompanied by the laceration of the nutrient artery, or extensive destruction of the soft parts generally. Under such circumstances, the necrosis is usually limited to the outer compact structure, the part ultimately coming away in the form of an exfoliation. Such an event, however, is by no means inevitable. The periosteum may be stripped off to a considerable extent, and yet, if the bone be in other respects healthy, or enjoy a tolerably active circulation, granulations will spring up, and thus gradually repair the breach. It is only when the vascular connection between the two structures has been materially impaired, or totally destroyed, that necrosis will be likely to ensue, the bone becoming white and dry, and eventually dark and even black. These appearances are well illustrated in what so often happens in compound fractures, attended with protrusion of the end of the bone divested of its fibrous covering, and in the phalanges of the fingers in whitlow.

It will thus be perceived, without going into further details, that death of the osseous tissue may be produced by constitutional or local causes, and that these causes differ in no respect whatever from those which induce mortification of the soft parts. Furthermore, it will be observed that they are such as usually give rise to inflammation generally in all structures without exception.

Extent.—Necrosis may be partial or complete, simple or complicated, superficial or deep; that is, it may affect merely a portion of a bone, or it may pervade its entire structure; it is said to be simple when it is limited to a single piece, and complicated when it attacks several, either simultaneously or consecutively. It is seldom that an entire bone perishes. Such an occurrence is sometimes observed in the pieces of the carpus and tarsus, in consequence of external injury, but it is extremely uncommon in the long bones; in these the shaft alone generally suffers, the articular ends retaining their vitality. Necrosis of the whole lower jaw has been repeatedly noticed as a result of the action of phosphorus, and some interesting cases in which the entire bone was successfully removed on account of this disease have been related by Dr. Carnochan and Dr. James R. Wood. Finally, necrosis may be limited to the outer surface of a bone, involving merely its superficial laminæ, the dead portion being ultimately detached in the form of a thin scale or plate; or it may invade its entire thickness, and then not unfrequently begins in the very depths of the cancellated tissue, in consequence generally of injury or disease of the medullary membrane.

The occurrence of necrosis, the elimination of the dead bone, usually called the sequester, and the formation of new bone as a substitute for the old, or that which has died, involve some very curious pathological and physiological processes, and therefore deserve attentive consideration. The symptoms which immediately precede, and those which accompany the death of the bone, are such, generally, as are denotive of violent inflammation, deep-seated, attended with excruciating pain, and rapidly tending to the suppurative crisis, the mischief being often done in a few days, and sometimes even in a few hours. Action, general as well as local, is excessive, and both the part and system occasionally fall a prey to its devastating influence, especially when there is involvement of a large neighboring joint, as now and then occurs when the necrosis attacks the inferior extremity of the femur, and extends into the knee. Progress, however, is not always so swift and overwhelming; often it is quite the reverse, the part and system suffering but little, and the malady pursuing apparently a chronic course.

A very common way in which the occurrence of gangrene of a long bone is announced is as follows. The patient, usually a lad from six to ten years of age, after having been overheated or exposed to severe cold, retires at night apparently perfectly well, but towards morning he is aroused by pain in the thigh or leg, deep-seated, circumscribed, of a sharp, aching character, and so excessively severe as to deprive him of further sleep and rest. The soft parts over the seat of the disease soon become exquisitely tender to the touch, swollen, and discolored, the surface having a glazed, dusky, reddish, or purplish tint, and pitting under pressure, in consequence of the infiltration of the subcutaneous cellular tissue. These local phenomena are always attended by severe constitutional disturbance. There is high raging fever, with a tendency to delirium, and excessive restlessness; the pulse is full, hard, and frequent; the skin is hot and dry; the thirst incessant; and the urine, thick and scanty, is surcharged with urates. By and by, violent rigors set in, succeeded by flushes of heat, the pain assumes a tensive, throbbing character, the swelling becomes more diffuse, extending often to a great distance up and down the limb, as well as widely circumferentially, the discoloration acquires an erysipelatous blush, and a careful examination soon detects, what, indeed, the existing symptoms sufficiently declare, the presence of pus, deep seated, lying partly between the affected bone and the periosteum, and partly on the outside of the membrane, in the cellular tissue of the muscles and aponeuroses, which it often extensively dissects and separates from each other, forming large pouches from which it is frequently difficult to dislodge it. Sometimes the abscess opens into a neighboring joint, and thus becomes a source of additional mischief, exciting inflammation in the synovial membrane, perhaps ultimately followed by destructive softening of the cartilage, and caries or necrosis of the end of the bone.

The quantity and quality of the matter found at this stage of the disease are very various. In the more severe cases it often amounts to several pints, whereas, under ordinary circumstances, it may not exceed that many ounces. The quantity furnished by the bone itself, or, rather, by the bone and periosteum, is always comparatively small, most of it being supplied by the soft structures over and around the seat of the disease. In most cases of spontaneous necrosis, it is found to be of a decidedly strumous character, being of a yellowish color, verging upon greenish, and of a thick cream-like consistence, interspersed with tough curdy matter, or flakes of lymph. In general it is more or less fetid—sometimes excessively so, particularly when long retained—and mixed with shreds of dead cellular tissue. Cases are met with where the matter is thin, ichorous, or sanious, but such an occurrence is unusual until after the bursting of the abscess, and the evacuation of its contents.

When the matter has been discharged, whether spontaneously or artificially, there is always a material improvement in the symptoms, both local and general, and an opportunity is now afforded for a thorough examination of the parts. The best instrument for this is the finger, or, when the opening is not sufficient or too devious, the probe. With either of these it is generally easy to determine the extent of destruction of the periosteum, or, at all events, of its separation, and the amount of injury sustained by the osseous tissue, the surface of the bone feeling rough, and having a whitish, grayish, or ashy hue, without any appearance whatever of vascularity.

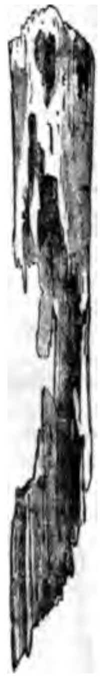
Such is a succinct account of the circumstances which immediately precede, accompany, and immediately succeed the occurrence of necrosis as it is usually met with at the bedside. The first stage of the disease is over; the matter consequent upon the inflammation has been discharged; and the inflammation itself has measurably subsided, the soft parts, however, being still swollen, indurated, tender, and painful, as well as entirely disqualified for the performance of their normal functions. Nature, never idle, now begins the double work of elimination and repair, both usually very tardy, often imperfect, and sometimes altogether unsatisfactory, the powers both of the part and system being inadequate to accomplish the object. In gangrene of the soft structures, the separation of the eschar is generally an easy matter compared with that of a bone, provided the patient's strength holds out; the process, once fairly commenced, proceeds rapidly and energetically, the surgeon each day seeing decisive evidence of the fact; soon the line of demarcation between the dead and living parts is perceived; then granulations are observed to spring up in the intervening chasm; and, finally, the reparative efforts still advancing, the breach is gradually closed over with new skin, a circumstance clearly denotive of the completion of the cure. But it is altogether different in necrosis; here the detachment of the slough is a matter of time, commonly requiring many weeks, and sometimes even a number of months, for its satisfactory conclusion, and even then generally demanding the interference of art before it can finally be effected. The cause of the difference is sufficiently obvious. In the one case there is an active circulation and an energetic system of absorbents, the former furnishing an abundance of plastic material for the repair of the lost tissues, and the latter exerting themselves to cast off the dead substance; in the other, on the contrary, everything is the reverse, and the parts labor under the additional disadvantage of being loaded with earthy matter, which is obliged to be softened and disintegrated before it can be removed by the vessels whose duty it is to get rid of it.

The necrosed substance may, as already seen, embrace merely a portion of the periphery of a bone, as, for example, its outer layer; or it may include its entire thickness, and also the greater part of its length. In the former case it constitutes, when detached, what is called an *exfoliation*, and in the latter a *sequester*, a distinction of considerable importance, not so much on account of the extent of the dead substance, as of the manner in which the breach of continuity is repaired, or a new bone formed.

An exfoliation is commonly merely a thin scale, plate, or lamella of the outer, peripheral portion of a long bone, of variable color and consistence. In general, it is either whitish, grayish, or of a light brownish hue, rough, more or less porous, and so brittle as to break under very slight pressure. No vessels are perceptible in it, and in most cases the animal matter seems to be almost completely abstracted. Maceration deprives it of its dark color, while immersion in dilute nitric acid for a few days completely destroys its proper texture, converting it into a soft, gristly substance.

The *sequester*, properly so called, varies much in size and shape, consisting, at one time, of a part only of the circumference or length of a bone, and, at another, of its entire shaft, with perhaps a portion of its articular ends. A rather common form is that represented in the adjoining sketch, fig. 292, from a preparation in my collection; it was a part of the body of the tibia, in which all the spongy structure was completely destroyed, while the compact was remarkably hard and firm. The dead bone is always rough, pitted, excavated, or spiculated; it is of a grayish, brownish, or blackish color, and emits, when struck with a probe or piece of metal, a peculiar hollow sound, by which it is usually readily distinguished from sound bone. In the cylindrical pieces, as in the femur and tibia, it is generally dense and dry; in the short and flat, on the contrary, it is porous, moist, brittle, and easily crumbled. The analyses of Von Bibra have shown that there is a very great reduction of organic matter in necrosis with a corresponding increase of earthy, the latter being as much as eighty per cent. of the entire mass. The same experimenter has proved that the difference is considerably less in the traumatic variety of the lesion than in the idiopathic.

Fig. 292.

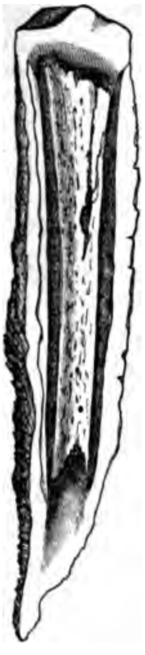


Necrosis of the tibia.

Reparation.—While the absorbents are engaged in detaching the dead bone, with a view to its ultimate expulsion, the capillaries take upon themselves the duty of throwing out material for the formation of the substitute, or new bone. The process by which this is accomplished is the same as that which presides over the creation of the original structure. The first step consists in a deposit of plasma, the result of the incited action of the vessels caused by the irritation of the necrosed bone, and this substance, becoming organized, is gradually converted into fibro-cartilage, which, in turn, gives way to cartilage, as this ultimately does to osseous matter, the period required for the completion of the development varying, according to the age and vigor of the patient, and the character and amount of the local disease, from a few weeks to several months. The new bone is at first a mere shell encasing the old, and thus serving to separate it from the surrounding parts, which ill brook its presence. In time, however, it increases in thickness, being often from three to six lines in depth, and occasionally, though not generally, it is fully as large as the original piece. Its surface is usually somewhat rough, and it is not uncommon to observe upon it considerable eminences and depressions, owing evidently to the irregularity of the developmental process. The new substance, too, has comparatively little areolar tissue, and hence, if some time have elapsed since its formation, it always cuts with great difficulty, the resistance offered by it being much greater than that of the pre-existing structure. In cases of long standing, indeed, it often acquires the solidity and density of ivory, so that it requires great patience and perseverance to penetrate it with the saw and pliers. The vessels, under such circumstances, are always very small and sparse, and the Haversian tubes are traced with difficulty. In the long pieces, after the death and removal of the shaft, there is never a complete reproduction of the medullary canal and its lining membrane, or of the endosteum. In fact, the new bone, although it possesses all the essential attributes of the osseous tissue, is, nevertheless, a very imperfect type of the original, and hence much less capable of resisting the effects of disease and accident.

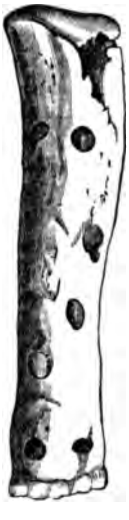
The appearances of the new bone, encasing the old or dead, are admirably depicted in fig. 293, taken from a specimen in the collection of Professor Pancoast. Owing to the ravages of the disease, amputation became necessary.

Fig. 293.



Necrosed tibia, the dead bone lying loose within the new.

Fig. 294.



Cloacæ in a necrosed tibia.

In viewing the new bone as it surrounds the old, its surface is found to be pierced by several apertures, to which, from their fancied resemblance to the rectal pouch of a bird, the term *cloacæ*, fig. 294, is usually applied. These openings, which play an important part in the expulsion of the dead bone, owe their existence to a deficiency of periosteum, or of secreting structure, as is proved by the fact that, when the formation of new osseous tissue goes on uniformly round every portion of the periphery, the old bone will be completely imprisoned, thus not only obscuring the diagnosis but rendering the removal of the sequester a matter of great difficulty and perplexity. The size of these cloacæ varies in different cases, from that of a three cent piece to that of a quarter of a dollar, their shape being generally rounded, or somewhat oval. Not unfrequently, however, they present themselves in the form of long, irregular fissures, or slits. Their number is indefinite; sometimes there is but one, while at other times there are as many as half a dozen, the latter number being by no means uncommon in necrosis of the shaft of the tibia. Whatever may be the size, form, or number of these apertures, they always communicate with the surface of the limb in which the affected bone is situated, the passages between them constituting so many channels for the discharge of matter and the ultimate elimination of the sequester, although this, owing to the inadequate dimensions of the cloacæ, is seldom effected without the intervention of art. It is an interesting fact, and one of no little practical value, that these openings are always situated in that portion of the new bone which is least covered by soft parts.

There has been much dispute among pathologists, as to the agents by which the new bone is produced, and the question can hardly be said to be even yet definitively settled. Without entering into any details, I may state, as the result of personal observation, that the perfection of the new bone will generally be found to be in proportion to the integrity and activity of the periosteum. I have always found that, when this membrane has suffered much during the inflammation which precedes and accompanies the necrosis, the reproductive process, or new osseous epigenesis, is tedious and difficult, and often extremely inadequate, the new bone being comparatively small and stunted, and, therefore, ill adapted to the purpose of a substitute bone. The part which the periosteum plays in the development of the new bone is well shown in the formation of cloacæ, which, as already stated, is clearly dependent upon the partial destruction of that membrane. If the periosteum everywhere retained its integrity, the new bone would be without a solitary opening, and the consequence would be that the sequester, or slough, would always be an encysted or imprisoned body. When this membrane has perished along with the bone, as occasionally happens in the shaft of the tibia or femur, the new bone will be formed by the surrounding structures, whatever these may be, but under such circumstances it is so imperfect, short, and thin, as hardly to deserve the name of substitute, to which, in general, it is so well entitled.

When the eschar presents itself as an exfoliation, or thin superficial scale, the breach is repaired through the medium of granulations, which, being derived from the old bone, are extremely vascular and sensitive, and soon assume the ossific process, throwing out an abundance of proper material for the accomplishment of the object. A similar process appears to be set up when the central portion of a bone perishes; for here the endosteum being also destroyed, it can have no agency in the reproductive act. When this membrane retains its vitality, it must necessarily exert an important influence as an epigenetic agent.

The idea has been broached, and warmly defended, that when the shaft of a bone is necrosed, so as to leave merely its articular ends, the new bone is formed exclusively by these ends, the osseous matter extending gradually towards the middle of the chasm, and ultimately coalescing there. Such a theory, however, is altogether untenable, being contrary to what occurs in the growth of the original bone, which always takes place by several distinct points, one of which is invariably central. However well the surviving extremities might perform their duty, yet, as there is no central nucleus, serving as a point of departure for the ossific matter, it is easy to conceive that the bone would always necessarily be so deficient at that particular spot as to disqualify it materially for the performance of any useful functions.

Symptoms.—The symptoms which attend necrosis, in its earlier stages, have already been pointed out; those which accompany the separation of the old bone and the formation of the new, are, in general, sufficiently characteristic. The most important of these are, little ulcers, surrounded by large unhealthy granulations, arranged in a papilla-like manner; sinuses leading from these ulcers down to the dead bone; and a discharge, more or less constant and copious, of thin, fetid, sanious matter, or of thick, white, inodorous pus; accompanied, in all cases, by a certain amount of hardness and swelling, pain and tenderness on pressure, wasting of the soft parts above and below the seat of the disease, and marked impairment of the functions of the neighboring joints. The general health always suffers; the patient is wan and emaciated; and, if the irritation is at all extensive, he will usually have hectic fever. In some cases the end of the sequester sticks out at one of the cloacæ, thus at once declaring the real nature of the complaint; but more commonly the dead bone is completely imprisoned by the new, and can only be reached by the probe or finger, carried along the sinuses leading from the surface to the cloacæ. In order to ascertain whether the separation has been effected, or whether the dead bone still maintains its relations, in some degree, with the living, the surgeon may often advantageously use two probes, introducing one at each extremity of the eschar, and moving them alternately in different directions, as may frequently be easily done when the detachment is complete. In general also useful information, in this respect, may be obtained from a consideration of the history of the case, as the size of the affected bone, the age of the patient, and the commencement of the attack. Thus, other things being equal, it will usually be found that a small bone will be more readily separated than a large one, and the bone of a young subject than that of an old one, while in every instance the process may be supposed to be more advanced in proportion to the period that has elapsed since the death of the bone.

Prognosis.—The prognosis of this disorder is variable. In general, it may be considered to be favorable when it is owing to external or local causes; when it is confined to the outer portion of a bone, the necrosis occurring in the form of an exfoliation; when it is simple and of moderate extent; and when the patient is young, robust, and of a good constitution. On the other hand, the cure is difficult, and the issue doubtful, when the disease is extensive and complicated with other affections; when it attacks pieces which are of high importance on account of their functions or situation; when it occupies the interior of a bone, and involves several parts of it; when it arises from an internal or constitutional cause, as struma or syphilis; when it extends into the adjacent joints, especially when these joints are of large size; and, lastly, when the patient is enfeebled by age, long suffering, or previous disease.

The time required for the development of the substitute bone will depend, as already stated, in great measure, upon the situation and extent of the disease, the age, health, and condition of the patient, and various other circumstances which will readily suggest themselves to the reader. That the whole of a necrosed bone may be regenerated, is a fact so well established as no longer to admit of any doubt. The new bone, however, as intimated elsewhere, is always, at best, only an imperfect copy, although, as it respects its functions, it usually answers the purpose well enough.

Treatment.—The treatment of necrosis must of necessity depend very much upon the circumstances of each particular case. There are three indications, however, which deserve special attention, the first of which is to limit and moderate the inflammation which is the immediate cause of the mischief, the second, to watch nature during the separation of the old bone and the formation of the new, and the third, to promote the removal of the sequester, slough, or eschar.

The first of these objects, which should always be kept clearly in view by the practitioner, is to be attained, of course, by the proper employment of antiphlogistic remedies; by the lancet, if the patient be plethoric, purgatives, the antimonial and saline mixture, light diet, repose, and the free use of opiates to allay pain and induce sleep. The affected parts, placed in an easy, elevated position, are leeched and fomented, or, what is particularly serviceable, painted with a strong solution of iodine at least three times in the twenty-four hours, the surface being protected in the intervals with an emollient anodyne cataplasm, or medicated water-dressing. In some instances, great benefit is derived from the application of a blister large enough to encircle nearly the whole of the affected limb, and kept on sufficiently long to produce thorough vesication. By these means, the surgeon not only limits the inflammation, but promotes the absorption of effused fluids, and hastens the suppurative crisis, which is always inevitable, to a greater or less degree, in every case of this kind. As soon as fluctuation is perceived, or even before, if there be inordinate pain and tension, or deep-seated matter, a large incision is made at one or more points, in the direction of the long axis of the bone, in the hope of saving osseous as well as soft tissue, especially the periosteum, the integrity of which is so essential to the development and formation of the substitute bone. In making the opening, due attention is, of course, had to drainage, and to the prevention of its premature closure.

The second indication is to watch the part and system during the sloughing process and the stage of reparation, in order that they may be enabled to perform with facility the arduous and important duties before them. The case requires active vigilance rather than active treatment; care, on the one hand, that the disease do not spread, and, on the other, that the debility consequent upon the drainage and irritation do not obtain the mastery, and so bring on fatal exhaustion. A certain amount of inflammation must necessarily attend both processes, and, therefore, action must not be too much repressed, lest nature be thwarted, or, at all events, embarrassed in her operations, operations which are both salutary and needful. A nutritious diet will generally be required, and the patient will often be immensely benefited by animal food and milk punch, ale, porter, or wine, and the use of quinine, iron, and aromatic sulphuric acid, especially if he have hectic fever and night-sweats. If he can move about on crutches, he should take gentle exercise daily in the open air; or, if this be impracticable, he should be pulled about in a hand-car, or be swung upon a hammock. Attention is, of course, paid to the bowels and secretions. Pain is allayed by anodynes. The principal local remedies are leeches, provided there is any disposition to over-action, the daily application of iodine, and the use of the bandage to support not merely the affected parts but also the distal portion of the limb, which, when this precaution is neglected, has usually a tendency to become œdematous. Fetor is allayed, and discharge moderated, by the chlorides, introduced by the syringe and sprinkled upon the dressings. Much has been said about the employment of solvents, thrown through the principal sinuses upon the dead bone, in the vain hope of promoting its gradual disintegration and elimination. Special stress used to be laid upon various acid solutions, particularly the nitric, hydrochloric, and pyroligneous; but experience has proved that they are always productive of harm, from their irritating effects upon the new bone and the soft parts, whilst, unless they are intolerably strong, they can exert no destructive influence whatever upon the sequester itself. If such lotions be employed at all, they should, therefore, be employed in the mildest possible form, simply with a view to their detergent and alterant effects, which are often very salutary, expediting the sloughing and restorative processes. In general, however, all the good that can be expected to result from such remedies may be accomplished by injections of tepid water, impregnated with Castile soap, a little potassa, or common salt, followed, if there be much fetor, by a weak solution of chlorinated soda. If new abscesses form, as occasionally happens, they must meet with prompt attention.

During this stage, a stage, I repeat, of comparative inactivity, inquiry is made into special diatheses, or states of the system. The patient may be strumous, and, therefore, be in need of anti-strumous remedies; or his system may be impregnated with the syphilitic posion, and a course of mercury, or of iodide of potassium, may be required. It must be obvious that no satisfactory progress can be made, in any case, towards a cure so long as the system is borne down by the pressure of a vitiated state of the solids and fluids.

The third indication is to get rid of the sequester, for so long as this remains it must necessarily act as an irritant, keeping up inflammation and discharge in the parts with which it lies in contact. It was generally supposed, until recently, that the dead bone, during its sojourn among the living tissues, was acted upon by the absorbent vessels, so as to diminish, more or less, its size and weight, the idea having apparently derived support from the altered and pitted condition of the surface of the affected piece. The notion, however, has been completely dispelled by the experiments of Mr. Gulliver, who ascertained, as might, indeed, have been anticipated, that such an occurrence is altogether impossible. Pieces of necrosed bone, carefully weighed before and after exposure, were confined on suppurating surfaces, in the medullary canal, and in the subcutaneous cellular substance for months, and in one instance for upwards of a year, without undergoing the slightest alteration whatever. A paper, detailing nineteen experiments of this kind, may be found in the twenty-first volume of the Transactions of the Medico-Chirurgical Society of London.

Seeing, then, that the dead bone acts as an extraneous body, and that it is in nowise amenable to the agency of the absorbents, the indication plainly is to remove it by operation. Such a step is the more imperative because of the manner in which it is imprisoned, the substitute bone forming a firm and solid case around it, and thus effectually preventing its extrusion. The only circumstance which should make the practitioner at all hesitate, is the doubt which may arise in his mind respecting the probability of the dead bone being completely detached, and the new one sufficiently advanced to enable it, after the removal of the sequester, to maintain its position without bending under the weight of the limb, in turning in bed, walking, or sitting. If he is satisfied of this, as he usually may be after a careful examination of all the facts of the case, he should at once proceed to adopt measures for the accomplishment of his object. The instruments which will be required for this purpose are various; but, in general, it will be necessary to have several scalpels, a trephine, a Hey's saw, an elevator, pliers, chisels, and stout forceps, with a good syringe for washing away the osseous *débris* after the operation is over. The adjoining cuts represent some of the more important of these instruments.

The incisions should always be made in the direction of the long axis of the bone, out of the way of the great vessels and nerves. The best plan usually is to select one of the principal cloacæ, or, when two or three are close together, especially if they be on the same plane, to connect them, thereby affording more room to work in. When the soft structures are much diseased, they may be included in an elliptical incision, as, in this event, it may be best to get rid of them. When it is deemed advisable to connect two or more cloacæ, the object may be easily attained by a Hey's saw, or, if the new bone is not very thick and firm, by the pliers. The trephine is chiefly of use when the openings in the substitute bone are very small, or when this bone possesses unusual density and thickness, rendering its division extremely difficult by the more ordinary instruments. Access having thus been obtained, the sequester is to be seized by one of its extremities, with a pair of forceps having long, thin blades, serrated on their inner surface, and from a third of an inch to half an inch in width, the handles being well curved, so as to facilitate prehension and maintenance.

When the sequester is unusually long, it may be necessary to divide it at the middle, and extract each piece separately; an operation which is always easily performed with the pliers or chisel.

The dead bone having been extracted, the next step is to wash out the canal left by its removal with a few syringefuls of cold water to clear away any little pieces, fragments, or *débris* that may have been left. Attention to this injunction, although generally neglected, will greatly expedite recovery by facilitating the growth of healthy granulations. The hemorrhage attending the operation is often quite free, the blood oozing out at every point, in consequence of the great vascularity of the parts, both osseous and soft, and occasionally requires plugging of the cavern with lint steeped in some styptic lotion, as a saturated solution of alum, or alum and tannin. It is not often that any artery requires to be tied.

Fig. 295.

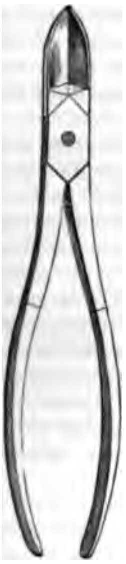


Fig. 296.

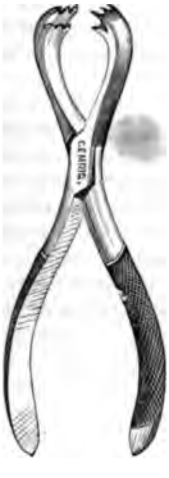


Fig. 297.

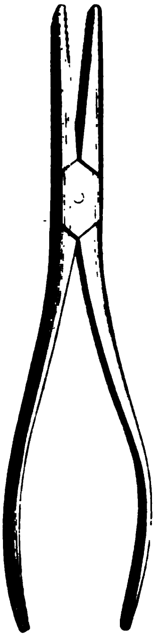


Fig. 298.

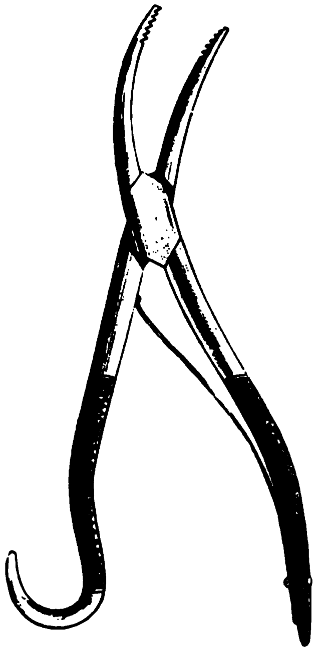
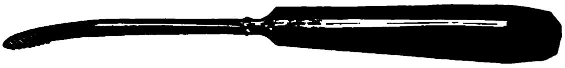


Fig. 299.



Instruments for removing dead bone.

The operation being completed, the edges of the wound are drawn lightly together with adhesive strips, and the limb, placed in an easy position, is bandaged from the distal end upwards, the parts more immediately affected being kept constantly wet with cold water, or a weak spirituous lotion. The dressings are removed in forty-eight hours, when the wound is well syringed, and covered with an emollient poultice, to favor the granulating process. The only general means usually required are light diet and a little attention to the bowels, with a full anodyne after the patient is put to bed. If the new bone is not sufficiently strong to prevent the limb from bending or breaking, it must be supported by appropriate splints, or a case made of sole-leather, gutta-percha, or trunk-maker

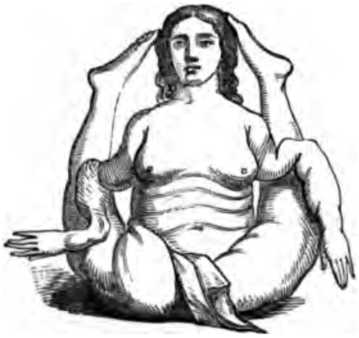
Soon after the sequester has been removed, whether by nature or art, the new osseous shell begins to contract, and by degrees assumes the shape of the old bone, which it is designed to replace. While this change is going on externally, osseous matter is deposited upon the inner surface of the shell, as well as upon the articular ends of the surviving portions, thereby gradually filling up the cavity, the period required for this being generally in proportion to the size of the eschar. The medullary canal, in case of there having been one, is, as already stated, seldom re-established.

It is not often, at the present day, that, with proper management, the practitioner is not able to effect a cure in necrosis; in general even with little deformity or loss of function. Cases do, however, occur, where, in consequence of neglect or injudicious treatment, the neighboring structures are so extensively and ruinously involved as to render it difficult, if not impossible, to save the patient without sacrificing the limb. Such an event will be particularly liable to happen when a large joint is implicated, as, for instance, that of the knee in necrosis of the thigh, or of the ankle in necrosis of the tibia. Under such circumstances, hardly anything short of amputation will be likely to answer; and a similar procedure may become necessary when the patient's constitution is so much shattered by previous or concomitant disease as to preclude the possibility of its holding out during the time which may be required for the separation of the dead bone from the living. In other cases, again, amputation may be demanded on account of hemorrhage from some large sinus, presenting itself either as a general oozing, or as a flow from an artery of considerable size, opened by ulcerative action, under circumstances when the loss of a few more ounces of blood might prove fatal. It is impossible, however, to exercise too much caution in attempting to decide so grave a question. In weighing the several points involved in its consideration, we must not lose sight of the fact that cases, apparently of the most forlorn character, where life literally hangs, as it were, by a thread, will sometimes promptly recover upon the removal of the dead bone. Finally, it must not be forgotten that excision of an entire bone has often been advantageously performed, especially of late years, recovery taking place with comparatively little deformity.

SECT. VII.—SOFTENING.

The essential characteristic of osteomalacia, mollities ossium, or softening of the bones, is a diminution of the firmness and solidity of the osseous tissue, depending upon the gradual removal of its earthy constituents, and the deposition of a reddish sero-albuminous, oily, or greasy substance. The malady is often confounded with rachitis, but differs from it in the circumstance, first, of its being a disorder of adult life; and secondly, in being always attended with severe pain; whereas rickets is peculiar to infancy, and free from local suffering.

Fig. 300.



Madame Supiot, in a posture quite practicable in the advanced stage of the disease.

Extent.—Softening of the osseous tissue varies in degree and extent, occurring at one time as a very slight affection, with hardly any appreciable change of structure, and at another as a most serious lesion, in which it is difficult to distinguish any trace of the normal substance. In regard to its extent, it may be general or partial, in the one case pervading the entire skeleton, while in the other it is limited to particular bones, or portions of bone. Of general osteomalacia, the case of Madame Supiot, which has long since become classical, and which has been so minutely described by Morand, the younger, in the Memoirs of the Academy of Sciences of Paris, for 1710, affords a characteristic, as well as a most extraordinary example, as shown in fig. 300. This female, who was thirty-seven years of age at the time of her death, had her bones so completely softened that they could be bent like wax, and put in almost any position, although she herself had lost all control over them, her head and left arm being the only parts she could move. Most generally the disorder is confined to particular bones, especially the ribs, sternum, vertebræ, and pelvic pieces.

Morbid Anatomy.—The osseous tissue in this disease gradually loses its firmness and solidity, becoming ultimately so soft and pliant that it may be easily bent, if not cut. It is of a pale reddish color, often inclining to yellow, is specifically lighter than the healthy structure, and is infiltrated with a turbid, viscid serum, removable by pressure. Occasionally the osseous fibres are widely separated from each other, so as to leave large cells, which are filled with a bloody-looking, adipose substance. When this is the case, the bone is sometimes remarkably pliant, bending like semi-concrete wax. Boiling completely dissolves it; and exposure to the air, by abstracting its moisture, sensibly diminishes its weight. Such are the principal changes observable in the osseous tissue. The periosteum over the affected part is abnormally thick, rough, and but feebly adherent; it is of a grayish hue, deeply injected, and, like the bone, infiltrated with sanguinolent matter. Upon being macerated, however, it is found to retain its fibrous structure. The marrow is converted into a reddish, greasy sanies; and the medullary membrane is wasted away to a few soft, cellular shreds. The cartilages sometimes participate in the softening, while the muscles are pale, atrophied, and infiltrated with a reddish fluid.

The softening generally involves the whole thickness of the bone; but cases occur in which the outer table remains unchanged, consisting of a thin, brittle shell. The disorder obviously consists either in an inordinate absorption of the phosphate of lime, upon which the solidity of the osseous structure naturally depends, or in a deficient deposition of this matter into its meshes. It has already been mentioned that the bones become specifically lighter in this disease; and Dr. Bostock has ascertained the additional fact that they contain nearly eighty parts of animal substance in the hundred. The experiments of this gentleman were afterwards confirmed by those of Dr. G. O. Rees, of London, who, from a careful analysis of three diseased specimens, taken from the same adult subject, obtained the following results, which he has compared with those furnished by healthy bone:—

	Diseased.		Healthy.	
	Earths.	Animal matter.	Earths.	Animal matter.
Fibula . .	32.50	67.50	60.02	39.98
Rib . .	30.00	70.00	57.49	42.51
Vertebra . .	26.13	73.87	57.42	42.58

On examining this table, it will be observed that, in the diseased as well as in the sound state, the fibula contains more earthy matter than the rib, and the rib more than the vertebra. In health, the vertebra and rib approach very nearly in their proportions of animal and saline ingredients, whereas, in softening, a considerable difference obtains.

Causes.—What are the causes of this remarkable disease, or the circumstances which influence its origin and development? Upon this subject, unfortunately, science is almost completely silent. A great variety of causes have been accused as being capable of producing it, [illegible] gouty, rheumatic, syphilitic, or scorbutic state of the system; but, in admitting such an agency, it should not be forgotten that vast numbers of persons labor under such a taint, and yet are never the subjects of osteomalacia. That it may occasionally induce softening of the osseous tissue is extremely probable; but that this occurrence is frequent all experience plainly contradicts. The whole course of the disease shows it to be essentially connected with a vitiated and depraved condition both of the solids and fluids; but whether the disorder of the one precedes that of the other, or whether they have a simultaneous origin, and afterwards keep steady and regular pace with each other, are questions which our knowledge is inadequate to solve. However provoked, it is sufficiently apparent that the structures which are its seat are in a state of inflammation, and that this inflammation plays an important part in the production of the changes which characterize it. We cannot, as rational pathologists, assume any other ground; for, how else can we account for the excessive vascularity of the affected tissue, the sanguinolent nature of the infiltrated fluids, the thickened, spongy, and congested condition of the periosteum, and, finally, the atrocious and constant pains which form so notable a feature in the history of osteomalacia? All these circumstances unerringly point to inflammation as the great agent in the production of these changes; changes which, when existing in the soft structures, are invariably referred to this cause, and to none other. The morbid action, whatever it may be, is always of a chronic character, and is attended with important lesion of nutrition, leading to the removal of the earthy matter of the bones, and the excretion of it from the system, or its deposition among parts where it does not naturally occur. Or, what is more probable, there is both absorption of the original solid structure and a want of secretion of new, thus causing a complete disintegration, or decomposition, of the osseous tissue. All these circumstances are sufficiently obvious and tangible; but if we attempt to go beyond them, we involve ourselves at once in difficulties, from which it is found impossible to extricate ourselves.

Age and Sex.—Osteomalacia is rarely seen before the age of puberty; its favorite period of attack is between the thirtieth and fiftieth year. Another singular feature in its history is that it takes place much more frequently in women than in men, in the proportion, it has been said, of ten to three, but upon this subject it is obviously impossible to give any definite information. It is most common in females who have borne several children, and in a number of instances it has seemed to commence within a short time after parturition. Several cases have been reported where it was hereditary, having been distinctly traced through three generations, but in none of the offspring did it show itself until after puberty.

Symptoms.—The invasion and progress of this disease are generally very insidious. The earliest, and, for a long time, the most prominent, symptom is pain in the limbs, spine, and pelvis, of a wandering, shifting character, which the patient usually supposes to be of a rheumatic nature, and which is often so severe as to cause immense distress, especially at night, and in damp, chilly states of the atmosphere. By and by, dyspnœa sets in, with palpitation of the heart, and a sense of constriction across the chest, and the patient is seized with an overwhelming feeling of prostration, which utterly unfits him for business, and usually compels him to keep his bed. If he attempts to walk his limbs bend under him, and if the effort be often repeated, they soon become badly curved; should his toe catch in the folds of the carpet, or should he be so unfortunate as to trip, or fall, or give his body a sudden twist, he will probably hear some of his bones crack, and yield under the superincumbent weight. Emaciation gradually takes place, the appetite is deranged, the skin is bathed with clammy perspiration, the tongue is foul, the bowels are irregular, being either costive or too loose, and the urine, surcharged with earthy phosphates, is very thick, heavy, of a whitish aspect, and frequently also albuminous. In the latter stages of the malady the saliva, tears, and sweat often contain similar ingredients. Great distortion frequently occurs, the bones bending in every direction, and thus effectually disqualifying them for the performance of their functions. The chest projects like that of a pigeon, the spine is bent laterally, as well as backwards, the pelvis is twisted, or rotated upon its axis, and the whole stature of the individual is sensibly diminished, the head being thrust down between the shoulders, which are unnaturally arched and prominent. Amidst all this disturbance, however, the intellect is unclouded, menstruation is perfect, and even conception is still possible. The period at which death occurs varies from a few months to several years, its approaches being usually very gradual, and the consequence of sheer exhaustion.

Diagnosis.—Osteomalacia is liable, as already stated, to be mistaken for rachitis. While it cannot be denied that the two diseases have several features in common with each other, it is equally certain that they possess sufficient points of dissimilarity to justify us in considering them as separate affections. The chief differences are the following: Osteomalacia is rarely seen before the age of twenty-five or thirty, while rachitis is altogether peculiar to infancy and childhood, the disease in the former attacking the bones after the completion of ossification, whereas, in the latter, it assails them before they are fully developed. In softening, the patient is harassed with excessive pain and an overwhelming sense of exhaustion; in rickets, on the contrary, there is a total absence of pain, and the little patient generally retains a good share of strength. In osteomalacia there is more deformity than in rachitis; the disease is also of a more fatal character, few persons getting well, whereas in rachitis recovery is the rule, death the exception. Softening is much more common in women than in men, especially in such as have had several children; rachitis, on the contrary, is nearly equally frequent in both sexes. In softening the urine always contains a large quantity of earthy matter, whereas in rickets this excretion is usually lateritious. Finally, the two affections are signalized by marked differences in their anatomical character. In osteomalacia the osseous structure is completely disintegrated and decomposed; in rachitis, on the other hand, it is merely modified, and therefore susceptible of restoration.

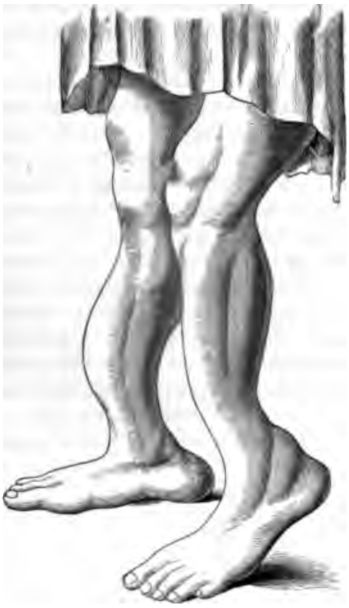
Prognosis.—Osteomalacia is generally a fatal disease. Hence Solly and some other authors are inclined to regard it as of a truly malignant character. Such an opinion is, of course, untenable, but it serves to show how exceedingly unmanageable the disease has hitherto proved to be in the hands even of the best practitioners. The period at which death occurs is very variable, some patients dying in a few months, others not under several years.

Treatment.—The progress of osteomalacia can be arrested only by causing a change in the action of the secernent vessels, but as we know of no means that are capable of doing this, all that can be done, in the present state of the science, is to endeavor to improve the general health by a well regulated diet and the employment of tonics, as iron and quinine, the shower bath, and change of air. Mercury has occasionally been administered, and carried to the extent of ptyalism, but, instead of proving beneficial, it has generally been productive of injury by still further exhausting the powers of life. Phosphate of lime, as having a tendency to supply the deficiency of osseous matter, has also been tried, but apparently with no better effect. If we adopt the idea that the disease is of an inflammatory nature, antiphlogistics ought to be advantageous, but thus far their employment has yielded no good results, but rather the reverse. When the disease is fully established, confinement in the bed or upon a soft elastic mattress will be necessary, and every precaution should be taken to avoid the occurrence of curvature and fracture of the affected bones. Pain must be relieved by the liberal use of anodynes.

SECT. VIII.—RACHITIS.

Rachitis, or rickets, is a disease of the osseous tissue, consisting in a deficiency both of its earthy and organic elements, as is shown by the diminished quantity of phosphate and carbonate of lime, and the absence of chondrin and gelatin, which form such important constituents of normal bone. The consequence is that the different classes of bone—the long, short, and flat—become so excessively softened as, in time, to yield under the slightest pressure, bending and twisting in various directions, and thus occasioning serious and generally irremediable deformity, as observed in the drawing, fig. 301, taken from a patient in the Philadelphia Hospital.

Fig. 301.



Rickets.

Rickets is emphatically a disease of early infancy, being most frequently witnessed from the eighteenth to the twentieth month, although many cases occur before the end of the first year. Now and then an instance is observed as late as the twelfth year; but this is extremely uncommon, and altogether contrary to the usual course of the affection. Occasionally rachitis shows itself as an intra-uterine malady. Both sexes are liable to it, and, apparently, nearly in an equal degree. Cases have occurred in which it seemed to be hereditary, or in which it attacked several members of the same family. It would appear from the accurate and masterly account of this disease by Glisson, published upwards of two centuries ago, that it first took its rise in the western parts of England about the year 1620, from which it gradually spread over the rest of Europe; where, however, especially in Great Britain, it is now comparatively rare. In this country it has always been extremely uncommon, even among the lower classes, whose children are its most frequent subjects.

Causes.—Much labor has been spent by writers in endeavoring to ascertain the exciting causes of rickets, but really to so little purpose that our knowledge regarding it can hardly be said, even at the present day, to be more accurate than it was in the time of Glisson and his immediate successors. From the circumstance of its appearing occasionally in several children of the same family, it has by many been considered as hereditary, nearly all the older, and not a few of the modern, authorities concurring in this view of its origin. It has also been supposed, and apparently with as little reason, to have an intimate connection with a syphilitic, strumous, or scorbutic state of the constitution. Others, again, have referred its origin to the influence of a vitiated atmosphere, such as results from living in damp, crowded, and ill-ventilated under-ground apartments; but it does not appear, so far as I am able to ascertain, that the children of such residents either in this or other countries are particularly prone to the complaint; certainly not so much so as to render it a special object of observation. Finally, there are many practitioners who look upon it as being due to the use of unwholesome or imperfect alimentation, causing an impoverished state of the blood, with lesion of innervation and nutrition; and this is, perhaps, as plausible a view as can at present be taken of the subject. With regard to its connection with scrofula, it may be observed that rickets rarely coexists with tubercle, and also that the former disease does not generally occur so early in life as the latter. If syphilis has any agency in the production of rachitis, it requires to be proved, which it has not yet been, that the offspring of persons laboring under that malady are more prone to its attacks than other children. Whatever the exciting cause may be, there is no question that the immediate one is a deficiency of phosphate and carbonate of lime, upon which the solidity of the osseous tissue essentially depends. How far the want of chondrin and gelatin, which are such important elements of healthy bone, may disqualify the osseous tissue in rachitis for the reception of earthy matter is a problem which has not been determined.

Morbid Anatomy.—The alterations of the osseous tissue consequent upon this disease may be conveniently arranged under three heads, each possessing marked peculiarities. In the first, the bones seem to be saturated with a reddish, watery fluid; a considerable quantity of which is also interposed between their outer surface and the periosteum, on the one hand, and between the medullary membrane and their internal walls, on the other. At a more advanced period, this fluid is replaced by a sort of gelatiniform substance, which, being particularly conspicuous in the situations here specified, becomes gradually organized and vascular, and ultimately adheres with great firmness to the parts with which it lies in contact. The periosteum is thickened and injected, the nutrient vessels are remarkably enlarged, and the medullary membrane is sensibly altered in its character; the changes which it has undergone being similar to those of the fibrous envelop just mentioned, though less in degree. The lamellæ of the long bones, naturally so hard and compact, are a good deal softened, while the areolar structure is greatly rarefied, many of the cells being more than double the natural size. Similar alterations are observed in the short and flat bones.

In the second stage, a peculiar spongoid substance is formed between the periosteum and the outer surface of the bones, varying from two to three lines, or upwards, in thickness; and which, by the pressure it exerts upon the lamellæ of the compact tissue, sometimes forces them inwards upon the medullary canal, thus greatly reducing it in size, if not entirely obliterating it. Simultaneously with these changes the bones are rendered so soft that they may easily be bent, cut, and even indented with the finger.

In the third stage—that of resolution—the recently formed substance in the long bones, as well as in some of the flat and short, assumes a compact character, and becomes gradually identified with the pre-existing tissues, which at the same time regain their primitive solidity. Owing to the presence of this new matter, the bones are much larger than in the natural state, and their firmness, especially in the adult, resembles that of ivory. Hence the term *eburnation* is sometimes applied to this state of the skeleton.

When rachitis proves fatal, the body is usually found in a state of excessive emaciation; the muscles are thin, pale, and flabby; the adipose matter is almost entirely consumed; the cerebral substance is unnaturally soft; the liver and spleen are enlarged and flaccid; the intestines are attenuated and distended with gas, and there is not unfrequently marked tumefaction of the muciparous glands; the mesenteric ganglions are increased in volume and consistence; the heart is softened and smaller than common; the lungs, which are often congested, are more or less tuberculized in about one-sixth of the cases; and the bronchical ganglions are hypertrophied, loaded with serosity, and of a deep purplish hue. Occasionally there is partial ossification of the arteries, muscles, and other structures, as if they had become the recipients of the earthy matter which naturally appertains to the bones.

Symptoms.—The symptoms of rickets possess nothing of a definite character in the earlier stages of the disease, the approaches of which are generally stealthy, and at times almost imperceptible. The child is observed gradually to lose its health and spirits, becoming dull and listless, and laboring under derangement of the digestive organs, especially flatulence and colicky pains. After a while, marked emaciation sets in; the muscles are soft and flabby; the abdomen is tympanitic; the skin is dry and sallow; the face looks pale and doughy; the urine is scanty, turbid, and lateritious; and the alvine evacuations are thin, watery, and fetid, there being nearly always considerable diarrhœa. Dentition advances slowly, and the teeth, having a black, fuliginous aspect, often begin to decay almost as soon as they have pierced the gums. The fontanels and sutures are more open than in the natural state; and the whole process of ossification is peculiarly slow and imperfect, or, rather, it may be said to be almost stationary, if not actually retrogressive. As the disease advances, the bones grow more and more soft, and, being unable to sustain the weight of the body or to resist the action of the muscles, are at length strangely and frightfully distorted. The head, although abnormally small, is disproportionately large to the size of the face, and is sunk down between the shoulders; the clavicles are bent and extremely salient; the spine is curved in various directions, especially laterally, and diminished in length; the pelvic bones are curved inwards, so as to lessen very materially the corresponding cavity; the ribs are flattened, and the chest, in consequence, is sensibly increased in its antero-posterior diameter, giving it a narrow, pigeon-shaped appearance. The bones of the extremities are shortened, bent, and twisted upon their axes, while their articular ends, or epiphyses, are softened, rarefied, and greatly expanded, thus appearing much larger and more prominent than naturally. If the child has begun to walk, he becomes daily more feeble on his legs; he waddles, trips, falls, and soon returns to his nurse's arms.

In rachitis, there is an actual arrest of development of the bones, and, although this want of growth pervades the entire skeleton, yet it is always most conspicuous in the lower extremities, the femur, tibia, and fibula being often fully one-third shorter than in the natural state, and also diminished in diameter, except at the epiphyses, which, as already seen, are always unusually large and prominent, especially if the child has been a good deal on his feet. Under such circumstances, the head and neck of the femur are sometimes forced by the weight of the body into a horizontal position below the level of the great trochanter; the individual is bow-legged, and the joints of the knee and ankle suffer great distortion from the weakened and relaxed condition of their ligaments. The flat bones, during the reparative process, become solidified and hypertrophied in their areolar texture, while the long ones are increased in thickness and strength along the concavity of their curvatures that they may be the better able to support the superincumbent pressure, and resist the effects of muscular action.

Diagnosis.—The only disease of the bones with which rachitis is at all liable to be confounded is osteomalacia or softening. The signs of distinction, however, are commonly very evident. In the first place, rachitis is an affection of infancy and early childhood, whereas mollescence never occurs until after middle age. Secondly, in rickets the softened and flexible state of the skeleton is only temporary; after a time, a process of repair is set up, and, gradually continuing, the affected tissues become at length more firm and compact than they are in the natural state; in osteomalacia, on the contrary, the disease, once begun, generally progresses until the patient is worn out by his suffering, no attempt being usually made at restoration. Thirdly, in rachitis there is no material alteration in the urine, whereas in mollescence this fluid is always loaded with a large quantity of earthy salts, the kidneys taking on a vicarious action, and so carrying off the material destined for the supply of the bones. Lastly, in rickets there is an actual arrest of development, in consequence of which the bones remain disproportionately short, thin, and dwarfish; in softening, on the contrary, the affected pieces retain their normal shape, although they are so changed in their consistence that they may readily be cut and bent in almost any direction.

Prognosis.—The prognosis of rachitis is generally unfavorable, for, although many patients escape with their lives, yet few recover without permanent deformity. In regard to the danger to life, it is commonly in proportion to the number of bones affected, the rapid progress of the complaint, and the age of the subject. Experience has determined that very young children are more liable to die of it than those who are more advanced in years, and those who are born of scrofulous parents than those who come into the world under more happy auspices. The duration of the disease is extremely variable; being very tardy at one time, and very rapid at another. In general, even under the most favorable circumstances, several years elapse before complete recovery occurs. The progress of the cure is often fatally arrested by some intercurrent malady, as measles, scarlatina, smallpox, or cholera. The longer recovery is postponed, the greater will be the danger of serious deformity. The duration of life is not necessarily shortened in persons who get well of rickets, cases having occurred of their having attained the age of sixty, seventy, or even seventy-five.

Treatment.—The treatment of rachitis is far from being satisfactory, or based upon sound philosophical principles. If, as has been asserted, every evil has its remedy, it is certain that human ingenuity has not yet succeeded in discovering any for this. The first point which it is of importance to inculcate is that, in rachitis, active measures are out of the question, our chief reliance being upon a properly regulated regimen and the use of tonics, with a view to the invigoration of the general system, and an improved condition of the blood, which, although it has never been thoroughly investigated in this disease, is beyond doubt materially altered in some of its component elements. Whatever, therefore, has a tendency to strengthen the patient, and enrich the circulating mass, must prove indirectly beneficial in removing the disease, and should claim serious consideration in every case.

The diet should be mild and nutritious, comprising an adequate amount of nourishment in the smallest possible space, so as not to oppress the stomach and create flatulence and acidity. The best article will, of course, be the mother's milk, or, when this is insufficient or unwholesome, fresh cow's milk, or, better still, the milk of the ass, which is now so much used in some of the larger cities of continental Europe, and which approaches nearer, in its composition, to human milk than that of any other animal. If the teeth are properly developed, a small amount of animal food will be useful, especially fat bacon, well boiled, and not too salt, with good stale bread, and a little mashed potato. The body should be washed at least twice a day with salt water, followed by dry friction, or rubbed with a moderately stiff salt towel; and, if the system be not too much reduced, cool or cold bathing will be found highly invigorating. Frequent exposure of the little patient to the fresh air, and exercise suited to his age and strength, are to be rigorously enforced. The secretions are to be improved by alteratives, especially blue mass and mercury with chalk, while the bowels must be [illegible] with rhubarb or oil, and acidity be allayed by the alkal [illegible]
and bicarbonate of soda.

Tonic medicines, particularly quinine and iron, given in small doses, and long continued, with an occasional intermission for a few days, are always imperatively indicated, and there are few cases which are not promptly benefited by their exhibition, especially in the early stages of the disease, although they are nearly equally useful throughout its entire progress. The mineral acids, and the tincture of the chloride of iron, have long been favorite medicines, both with the empiric and the regular practitioner, and are particularly advisable when there is a coexistent scorbutic condition. Alterative doses of mercury occasionally exercise a salutary influence, especially when the patient labors under the strumous diathesis, the best form being the bichloride, in combination with a small quantity of iodide of potassium, dissolved in water. The pain, which is often considerable, is controlled by opiates, either alone, or conjoined with diaphoretics.

Lately, the phosphates, which were formerly so much employed in the treatment of rachitis, on the ground that they would tend to supply the deficiency of earthy matter, have again come into vogue, but it remains to be seen whether they really possess any advantage over the more ordinary tonic remedies, already referred to, or whether they are not, indeed, inferior to them. Their best form of exhibition is the syrup.

Doubtless, however, the best remedy of all in this complaint, so far as any individual article is concerned, is cod-liver oil, given several times a day, in doses suited to the age and other circumstances of the patient. Possessing highly nutritive and alterative properties, it is admirably adapted to support the system, to enrich the blood, and to improve the secernent powers, which are so much at fault in rachitis. It may be administered either alone or in union with some of the more important tonics above mentioned.

Finally, the bed on which the rickety child sleeps should be perfectly smooth and somewhat elastic, so as not to permit the affected bones to sink down into any depressions or hollows, and so become bent and distorted. No pillow should be used, the head, body, and limbs all resting on the same plane. The clothes should be loose and light, but sufficiently warm to afford the requisite protection to the surface. In the earlier stages of the complaint, mechanical contrivances may not only be regarded as altogether ineffectual, but as pernicious; by and by, however, as the bones become softened, they should be supported with appropriate apparatus, to prevent deformity. Walking must, of course, be avoided as long as the extremities are unable to bear the weight of the body.

SECT. IX.—FRAGILITY.

Fragility of the osseous tissue is one of those affections which are to be regarded rather as an effect of disease than as a disease itself. It consists, as the name implies, in a peculiar brittleness of the bones, in which, especially in its more advanced stages, their substance is so completely changed in its character as to give way under the most trivial circumstances. All the bones are liable to this morbid brittleness, and cases occur, although rarely, where it literally pervades the whole skeleton. In 1857, the body of a female, supposed to be upwards of seventy years old, was brought into the dissecting-rooms of the Jefferson Medical College, with upwards of eighty fractures, received a few days before in a fall from a third story window upon the pavement below. Nearly all the ribs, several of the vertebræ, and a number of the long bones were broken, and signs of former fractures existed in the humerus, thigh, scapula, and other pieces. Devergie examined the body of a woman who died under symptoms of fragility, in whose skeleton there were not less than eighty-three fractures. Dr. Gibson met with a young man, whom I also saw many years ago, the bones of whose extremities were repeatedly broken by the most trivial accidents. The clavicles had suffered still more frequently, having been fractured altogether eight times. This universal fragility of the osseous tissue occasionally occurs at a very early period; sometimes, indeed, even in the fœtus in the womb. Chaussier met with a remarkable example of this kind, where the long bones had experienced not less than one hundred and thirteen fractures, some being at the time perfectly consolidated, thus showing that they had taken place some time previously, while the rest were either recent or had partially united. The child survived its birth only twenty-four hours. General fragility, however, is a comparatively rare affection; usually it is limited to particular bones, or, still more commonly, to particular portions of a bone; and those which are most prone to suffer are the head and neck of the femur, the ribs, sternum, radius, ulna, clavicle, and superior extremity of the humerus.

When the affection exists in its highest state of development, the slightest accident is frequently sufficient to produce fracture, as a severe fit of coughing, kneeling upon a hard floor, or turning about in bed. Sometimes, indeed, the fragility is so great that the individual cannot be touched rudely, without the occurrence of the injury. Of this description was the memorable case of the woman, whose history has been recorded by Saviard, who could not be moved about in bed without breaking some of her bones. After a confinement of six months she died, when it was found that she had had fractures in all the long bones of the extremities, as well as of the clavicles, ribs, vertebræ, and pelvis, many of the pieces being so brittle that they could not be handled without crumbling into fragments, similar to old, dry bark.

Causes.—Fragility of the bones commonly comes on without any assignable cause, and the general health not unfrequently continues good until a long time after it has made its appearance. In most cases, if not in all, it is merely symptomatic of some other disease, particularly of rheumatism, gout, syphilis, scrofula, and scurvy, attended with an altered and impoverished state of the blood, and impairment of the assimilative powers. The bones themselves are very much in the condition in which they are in osteomalacia, that is, their substance is more or less softened, in consequence of the removal of a large proportion of their phosphatic material, and they are often so completely saturated with fat as to render them unfit for preparations. On the other hand, however, they are sometimes remarkably dry and brittle. These facts would seem to show that their intimate structure undergoes some important anatomical change, the immediate result, it would appear, of inflammation, not of an active but tardy character. What tends to support this view of the nature of the affection is the circumstance that long before the bones manifest any disposition to break, the patient is harassed with severe pains, deep-seated, fixed, and referred to particular portions of the skeleton, and that, upon dissection, the diseased parts are generally found to be extremely vascular, their areolar structure being profoundly injected and infiltrated with bloody matter, apparently impoverished lymph, while the periosteum is very thick, spongy, and highly congested.

Fragility of the bones is one of the usual attendants upon old age. As we advance in life, their vascularity sensibly diminishes, many of the vessels shrinking down, and becoming finally entirely obliterated. It is owing to this circumstance that old persons, especially females after the fifty-fifth and sixtieth years, are so much more liable to fracture than to dislocation, the part most prone to yield being the neck of the femur within the capsular ligament, whose areolar tissue is often astonishingly rarefied, while the compact is hardly as thick as ordinary letter paper.

This affection is sometimes observed in several members of the same [illegible]

Dr. Pauli, of Landau, has related an instance where it was distinctly traceable through three generations on the father's side. All the grandchildren, five in number, had each had several fractures, one as many as five, in the bones of the extremities, and that mostly as the result of inconsiderable injury. They were all remarkably healthy, and there was no evidence in any of them of a scrofulous taint of the system.

Symptoms.—There are, unfortunately, no reliable signs in this affection. Hence it is usually overlooked until it has reached its highest point of development, when it is always incurable. In general, the person is laboring under severe pain, which is usually regarded as of a gouty, rheumatic, or syphilitic character, and which is rarely, under any circumstances, referred to its proper source, until after the occurrence of curvature, or fracture, from causes so slight as to awaken, for the first time, a suspicion of the existence of disease of the osseous tissue. As the disorder progresses, the appetite and strength become impaired, the pains increase in violence, and the urine is surcharged with earthy constituents, especially phosphate and carbonate of lime. This alteration in the urine is observable at an early period, and, in general fragility, goes on gradually augmenting down to the time of death, which happens at from six to eighteen months, the patient meanwhile being perfectly bedridden.

There are, then, only two circumstances which can be at all relied upon as diagnostic of this complaint; one is the severe and intractable character of the pain, deep-seated, and usually referred to the bones; the other, the altered condition of the urine, as declared by the presence of an inordinate quantity of earthy matter, especially phosphatic. When these co-exist, the suspicion will be strong that there is serious lesion going on in the skeleton, and this suspicion will be converted into certainty when, superadded to them, there occurs, without any considerable external violence, curvature, fracture, or displacement of some of the bones.

Fragility, like softening, may generally be looked upon as an incurable affection. The only exception, perhaps, to this rule is when it occurs as an effect of the syphilitic or rheumatic poison, and even then it seldom admits of complete relief unless it presents itself in a very circumscribed form. The fragility of old age is always incurable.

Treatment.—No rational treatment has yet been laid down for this disease, nor will it be possible to do so until we shall have more enlightened views of its etiology, pathology and diagnosis. Until, therefore, we are placed in possession of substantial information upon these points, our treatment must necessarily be altogether empirical. In all cases, strict inquiry should be instituted into the origin of the disorder, when such remedies should be administered as the result may seem to indicate. As a general rule, it may be stated that bleeding, except in very robust habits, is quite inadmissible, and even active purgation usually proves injurious. A tonic and supporting course, consisting of the different preparations of iron and quinine, and of the syrup of the phosphates, along with cod-liver oil, and vegetable acids, especially the citric, and a well-regulated, nutritious diet will afford the best chance of relief. Iodide of potassium and bichloride of mercury may be given in the syphilitic variety of the disorder; while in the gouty and rheumatic forms, colchicum would probably prove beneficial. To relieve the excessive pain which is so prominent a symptom in the latter stages of the affection, especially when it involves a large portion of the skeleton, anodynes must be given in full doses once or twice in the twenty-four hours. Curvatures and fractures must be treated upon general principles. In most cases, the bones unite nearly as readily as under ordinary circumstances; sometimes, however, the process is very tedious, and at other times they refuse altogether to unite.

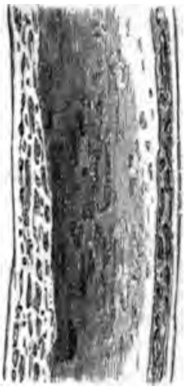
SECT. X.—ATROPHY.

Atrophy of the osseous tissue is characterized by the partial absorption of its elementary constituents, as is evinced by its lightness and porosity. It may occur in any portion of the skeleton, but the long bones are oftener affected than the short or flat. Like hypertrophy, it may be partial or general; that is, it may involve an entire piece, or be limited to a particular part of it. Atrophy, moreover, may be concentric or eccentric. In the former variety the bone is diminished in its diameter; in the latter it retains its original size, but is reduced in weight, and rarefied in its tissue. The causes under the influence of which it may take place are, protracted pressure, chronic inflammation, deficient nervous influence, and insufficient supply of arterial blood.

a. The influence of *pressure* steadily exerted for a considerable length of time, in producing atrophy of the osseous tissue, is well exemplified in the cranial bones in tumors of the dura mater; in the sternum and dorsal vertebræ in aneurism of the aorta; and in the ribs in cancer of the mammary gland. In all these instances the compact substance is reduced to a thin, translucent plate, while the spongy texture is either wholly destroyed, or worn down to a few slender threads. The immediate cause of the wasting process here is absorption, acting simultaneously and equally upon the animal and earthy constituents.

b. Atrophy from *chronic inflammation* is probably infrequent. One of the best specimens of it that I have ever seen occurred in a colored woman, who died of pulmonary phthisis at the age of forty. The body was much emaciated, and all the long bones were remarkably reduced in weight, though they had experienced no change in their external configuration. The compact substance was wasted to a mere shell, scarcely thicker than common wrapping paper, while the cells of the spongy texture were increased many times beyond the natural size. The medullary canal was much enlarged, and filled with a greasy, reddish substance, not unlike fresh adipocire. These appearances are well shown in fig. 302, and afford a beautiful illustration of the eccentric form of atrophy.

Fig. 302.



Atrophy of bone.

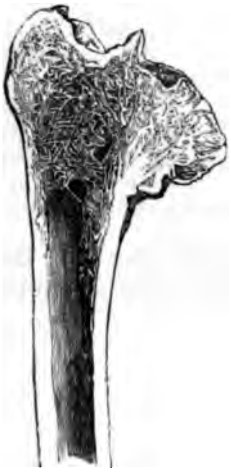
Atrophy is sometimes the result of local injury, as a blow, wound, or contusion. The wasting in this case may be limited to the site of the original mischief, or it may extend to the entire bone, which, however, is rare. In what manner such an injury operates, whether through the agency of inflammatory irritation, or otherwise, in giving rise to atrophy, is unknown.

c. Deficient *nervous influence* is a frequent cause of atrophy both of the osseous tissue and of the soft parts. In paralysis of the lower extremities, there is generally notable wasting, not only of the muscles, but also of the long bones, which are greatly reduced in weight, rarefied in their texture and diminished in size.

d. The effect of a *diminished supply of blood* in inducing atrophy of bone is sometimes very conspicuous in old fractures. In such injuries there is often considerable wasting of the osseous tissue, in consequence merely of the obliteration of the nutrient artery by the pressure of the callus. The atrophy is always eccentric, and is usually limited to one-third, one-half, or two-thirds of the affected bone, according to the seat of the original injury, or, more properly speaking, the quantity of the new matter, and the extent of the vascular obliteration.

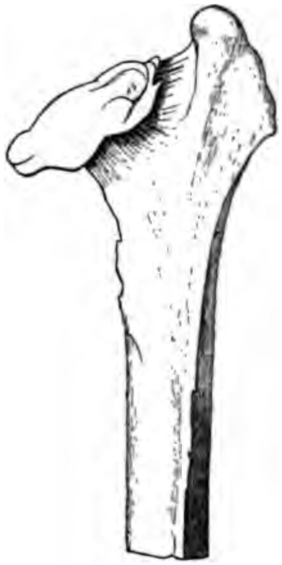
e. Finally, there is what is termed *senile atrophy*. In old age, the bones are rendered light, porous, and brittle; the compact substance is reduced to a mere parchment-like shell, while the areolar texture is remarkably rarefied or expanded; the muscular prominences are diminished in size; the animal matter is partially absorbed; and many of the vessels are obliterated. These changes are nowhere more conspicuous than in the neck of the femur, which, in consequence, often breaks from the most trifling causes, and which, after this occurrence, is seldom, if ever, repaired by osseous matter. Fig. 303 is a section of a well-marked specimen of this kind; the internal structure is very much rarefied; and the head of the bone, flattened and expanded, is approximated to the shaft, from the partial absorption of its neck. Fig. 304 exhibits the affection in a still more advanced stage.

Fig. 303.



Atrophy of cellular structure of the thigh-bone.

Fig. 304.



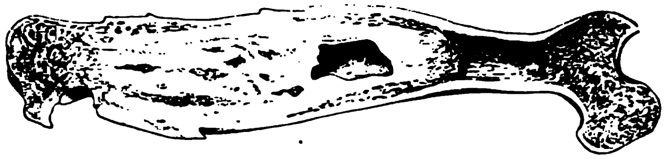
Advanced stage of senile atrophy of the thigh-bone.

Atrophy of the osseous tissue does not admit of cure. All that the surgeon can do is to amend the general health, when that is at fault, and to remove any local causes of disease when they are found to exist.

SECT. XI.—HYPERTROPHY.

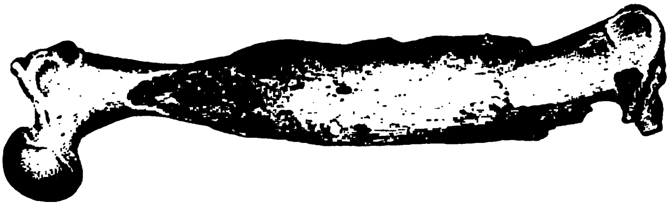
Hypertrophy of the osseous tissue may be partial or general; that is, the abnormal growth may affect either a portion or the whole of a bone. The latter, however, is a very rare occurrence, though perhaps not so much so as has been imagined. Cases, indeed, not unfrequently occur in which the broad bones of the head present an extraordinary degree of development, being more than an inch in thickness, and so hard that it is almost impossible to saw them. Under these circumstances, the two tables are extremely compact, the intermediate spongy structure being totally obliterated, or, rather, replaced by dense earthy matter. Similar appearances are sometimes witnessed in the cylindrical bones of the extremities. In an old femur in my private collection, the medullary canal is scarcely large enough to admit a common-sized quill; the whole shaft consists almost entirely of compact substance, in many places more than six lines in thickness. The bones of the male are always larger and more distinctly developed than those of the female, and the bones of persons who take much exercise than those who are indolent, or inactive. By labor, their weight and dimensions increase; their spongy structure diminishes, whilst the compact becomes harder and more dense, and acquires an almost rock-like solidity; the muscular prominences are rendered more conspicuous; in short, everything indicates that they are in a state of general hypertrophy. The osseous tissue usually contains a due proportion of animal matter, and hence it does not readily yield under external injury.

Fig. 305.



General hypertrophy—internal structure.

Fig. 306.

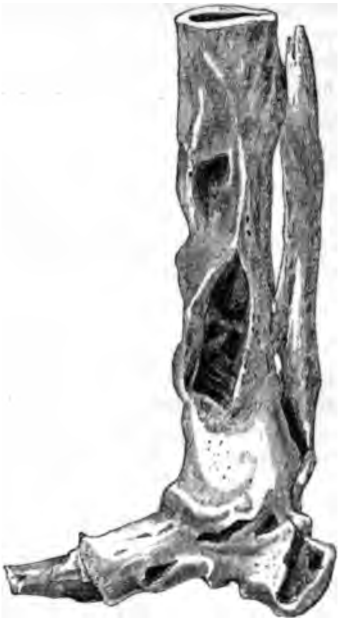


General hypertrophy—external characters.

The adjoining cuts are excellent representations of general hypertrophy of the femur of a man affected with tertiary syphilis. Fig. 305 is a section of the bone exhibiting its interior structure, which is very much condensed throughout, except at the superior extremity, where there are still some remains of the areolar tissue; the medullary canal is entirely obliterated, and the weight of the bone is nearly twice as great as in health. Fig. 306 shows the external appearance of the bone. The drawings are from a specimen in my cabinet.

The adjoining sketch, fig. 307, is a specimen of hypertrophy of the bones of the leg and foot, both in thickness and length. It

Fig. 307.



Hypertrophy involving both the thickness and length of the bone.

is from a drawing of a preparation in the collection of Professor Buchanan, of Nashville. All the bones are much enlarged, increased in weight, and anchylosed, at the ankle, tarsal, and metatarsal joints. The interosseous ligament was completely ossified. The foot and leg had been the seat of extensive ulceration, followed by exfoliation from the hypertrophied bones.

General hypertrophy of the bones is usually incurable. It is only, or chiefly, when it depends upon a syphilitic taint of the system that it admits of relief; but as this subject has already been fully discussed elsewhere, it is not necessary to revert to it here.

SECT. XII.—TUMORS.

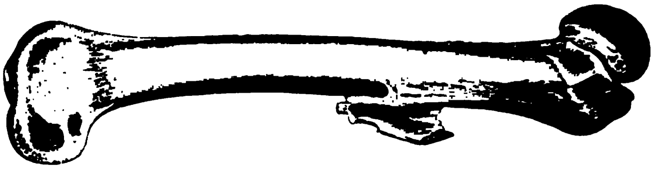
The bones, like the soft structures, are liable to two classes of tumors, the innocent and the malignant. The former includes exostosis, fibro-cartilaginous growths, aneurism, hematoid formations, serous cysts, hydatids, and myeloid tumors; the latter, encephaloid, colloid, scirrhus, and melanosis.

INNOCENT FORMATIONS.

1. EXOSTOSES OR BONY TUMORS.

An exostosis, of which fig. 308 affords a good idea, is an osseous outgrowth, the word, which is a Greek compound, signifying a bone growing from a bone. It is in fact a local hypertrophy, a circumscribed tumor, possessing essentially the same structure as the bone from which it springs, and with whose substance it is usually intimately identified. There is perhaps no term in surgical nomenclature which has been more abused than this, or which has been applied to so many different and almost diametrically opposite diseases. Among those who have especially contributed to bring about this confusion may be cited the name of Sir Astley Cooper, who, under the appellation of exostosis, has described almost every variety of tumor, whether benign or malignant, whether fleshy, fibrous, cartilaginous, or osseous, connected with or growing from a bone. This classification, which was for a long time blindly followed by most writers, has recently given way to a more correct appreciation of the subject, and I know no pathologist whose opinion is worth much who does not consider an exostosis as essentially a local hypertrophy, free from malignancy, formed in the same manner as the primitive osseous tissue, and composed essentially of the same anatomical elements; in short, as a bone growing from a bone, and not upon a bone.

Fig. 308.



Exostosis of the thigh-bone.

Exostosis is observed chiefly in young and middle-aged subjects, being very infrequent before puberty, and after the fiftieth year. It is more common in males than in females, and is generally confined to particular bones, as those of the cranium and of the extremities, particularly the femur, and the phalanx of the great toe.

The superior maxillary sinus is occasionally the seat of this disease. In a specimen in my collection, the inner surface of the left antrum is literally studded with these growths, none of which exceed a small grain of wheat, which they also much resemble in shape. The tumor sometimes acquires an enormous bulk, and cases occur in which both cavities are affected simultaneously, though not in the same degree.

In the flat bones, as those of the head and pelvis, the outgrowth may occur upon either surface; in general, however, it evinces a preference for the external one, probably because it has a more perfect periosteum. When the tumor is attached to the inner surface, its tendency is to encroach more or less seriously upon the contents of the cavity which the bone assists in forming. These internal exostoses, as they may be termed, are most common in the cranial bones of syphilitic subjects.

A tendency to exostoses is sometimes observed in several members of the same family. A few years ago, I had a lady under my charge on account of a tumor of this kind on the shaft of the left radius, whose sister and brother had each a similar enlargement, the former on the occipital bone, and the latter on the clavicle. Boyer gives the particulars of a case where the disease was hereditary, the patient's father, brothers, sisters, nephews, and children, having all suffered in a similar manner.

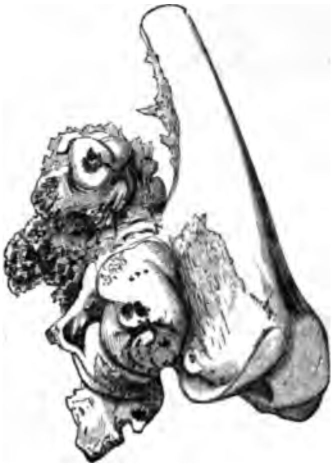
The number of these outgrowths varies from one to a considerable number. In general, they are solitary; but cases occur where there are a great many, as if there existed a sort of exostosic diathesis, as in fact there does under such circumstances. In the Mütter collection is the skeleton of a female in which a large number of bones are thus affected.

Exostoses sometimes observe a symmetrical arrangement, tumors of the same size and shape occurring at the same points of the corresponding bones of the two sides. Such a disposition is occasionally witnessed on the frontal bone and lower jaw, but is most common on the humerus and femur, especially the inferior extremities of these pieces.

The *volume* of these growths is subject to no little diversity, some being very small, while others are extremely large, cases being occasionally noticed where they are of the size of an adult head. The most voluminous are usually found upon the bones of the extremities, particularly the lower part of the femur, though they are also sometimes seen upon the cranial, facial, and pelvic bones, where their presence is a source of the most hideous deformity.

Their *shape* is also very variable; sometimes they have a distinct, well-defined outline, being of a globular, ovoidal, or hemispherical figure; occasionally they jut out like long, slender spines or stalactites; in another series of cases, they have a knobby, nodulated, tubercular, or mammillated appearance; and, lastly, instances occur, although they are rare, in which they present themselves in the form of plates or lamellæ. These varieties of shape are doubtless entirely due to accidental circumstances; but they, nevertheless, deserve attention, on account of their practical relations. In regard to their surface, this may be either perfectly smooth, scabrous, or spiculated; most generally the latter.

Fig. 309.



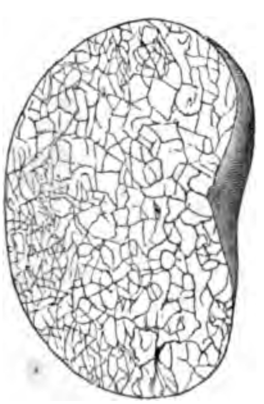
Exostosis of the femur.

The adjoining sketch, fig. 309, represents a remarkable form of exostosis, from a drawing of a specimen kindly presented to me by Dr. Lewis, of Alexandria. It grew upon the right femur of a lady, fifty-one years old, having commenced when she was only nine years of age. The tumor, before removal, was about the volume of a cocoa-nut, oval, smooth, and very hard. The integuments over its summit had latterly become inflamed and ulcerated, followed by a discharge of sanious matter, and the protrusion of a portion of bone. The general health becoming somewhat impaired, amputation was performed at the lower third of the thigh, the woman making an excellent recovery. This case is additionally interesting from the circumstance that several of the relatives of the patient had been affected with similar tumors.

Causes.—The origin of exostoses is involved in doubt. There is no question that, in the great majority of instances, they arise without any assignable cause whatever. On the other hand, they can often be traced directly to the effects of external violence, such as a blow or kick. In the distal phalanx of the great toe, which is not an uncommon seat of the disease, it would seem probable that the pressure of a tight boot is able to produce it. Exostosis in the stump after amputation of the thigh and leg is probably caused by the jarring which the femur and tibia experience during the operation of sawing, aided, perhaps, by a partial laceration of the periosteum. A syphilitic taint of the system has generally been considered as an excitant of the complaint, and that it is capable of exerting such an influence hardly admits of doubt. Nevertheless, it is extremely probable that its agency has been greatly overrated; for I can recall but few cases that have come under my observation where it was possible to trace the relationship in a satisfactory manner. Rheumatism and gout are also often accused of causing exostosis, and although it is impossible, in the existing state of the science, to determine the character and degree of their agency in this respect, yet sufficient is known to justify the belief that it is very considerable. However this may be, it is extremely probable that these diseases play a most important part in the production of general exostoses, the history of most of the cases of the kind clearly proving such a connection.

Whatever may be the exciting cause of exostosis, there can be no doubt that the immediate cause is inflammation leading to a deposit, in the first instance, of plastic matter, and afterwards, of osseous, the process of development being precisely similar to that which presides over the formation of the original bone. The concomitant inflammation is not always seated exclusively in the bone, but partly in the bone and partly in the periosteum; and cases occur where there is reason to believe that the latter is mainly involved in the production of the tumor.

Fig. 310.



An ivory-like exostosis, showing its internal structure.

Structure.—In regard to its structure, an exostosis differs in no wise from healthy bone. It is essentially composed of two parts, a compact and an areolar, the former inclosing the latter like a dense, firm layer, varying in thickness from the sixth of a line to a quarter of an inch, according to the volume of the tumor. The compact substance sometimes constitutes the greater bulk of the morbid mass, and there are cases, especially when it involves the cranium, where it is of the consistence of ivory, being so close and hard as to render it extremely difficult to saw it. Such a structure is represented in fig. 310, from a specimen in my collection. The areolar texture is sometimes directly continuous with that of the bone from which the exostosis grows; at other times, however, it is independent of it, being either in immediate contact with the compact structure, or separated from it by a stratum of fibro-cartilage, cartilage, or fibrous tissue. Its cells are of variable size and form, and are generally loaded with fatty matter, just as in a short bone of the skeleton, or in the articular extremity of the long.

The identity of the structure of exostosis with that of natural bone is proved, moreover, by *chemical* analysis. Even when the new substance is of unusual firmness, as in the eburnized variety of exostosis, the difference is much less than might, at first sight, be imagined. The following comparative analyses of healthy bone and of an ivory exostosis, by Berzelius, places the subject in a strong light. The principal difference, it will be observed, consists in the presence, in the latter, of an unusual quantity of phosphate of lime, and in a marked diminution of carbonate of lime and salts.

	Healthy Bone.	Eburnized Exostosis.
Animal matter	33.30	28.57
Phosphate of lime and magnesia . .	54.20	68.88
Carbonate of lime and salts . . .	12.50	2.00
Loss	00.00	00.55
	100.00	100.00

When an exostosis is seated in a part of the body which is habitually the subject of considerable motion, as, for example, the inferior portion of the femur, it is usually surrounded by a distinct capsule, a sort of synovial burse, the object of which evidently is to ward off friction and facilitate gliding. The inner surface of the capsule, which is of a fibro-cellular nature, and of variable thickness, is perfectly smooth, unadherent, and lubricated by a sero-oleaginous fluid, so as to qualify it the better for the performance of its functions. Where no motion is required, the growth lies in immediate contact with the natural structures, the union between them being commonly so intimate as to demand a careful use of the knife to effect their separation. Occasionally, indeed, the soft parts are partially imprisoned in the osseous tumor, thereby rendering the dissection peculiarly tedious and difficult.

Progress.—The progress of this disease is generally tardy; it is only now and then that a case occurs which pursues a different course, or where the symptoms partake of an acute character. A syphilitic exostosis occasionally attains a considerable bulk in a short time, and the same thing has been observed, though less frequently, in the rheumatic form of the complaint. Under such circumstances, the formation of the tumor is generally attended with severe pain, liable to nocturnal exacerbations, tenderness and swelling of the part, and more or less constitutional disturbance. Ordinarily, however, there is nothing of the kind; the disease comes on slowly and almost imperceptibly, the first thing that arrests attention being a small tumor, which is altogether insensible, and exceedingly tardy in its progress, years elapsing before it acquires the size, perhaps, of a pullet's egg. If it be superficial, so as to admit of examination, it will be found to be hard and immovable from the first, and so it generally continues ever afterwards, whatever may be its bulk. Meanwhile, although it may itself be entirely indolent, yet it may be productive of pain in the surrounding structures, by the compression which it exerts upon the nerves, and in this way the suffering is sometimes rendered exceedingly severe, being often of a neuralgic character, darting about in different directions, and extending far beyond the seat of the bony growth. When the tumor is situated in parts which are much exposed to motion, these parts are liable to become inflamed and tender, thus greatly aggravating the local distress. As the morbid mass enlarges it must necessarily act obstructingly, interfering with the functions of the affected structures, and ultimately, perhaps, entirely abolishing them. Thus an exostosis of the orbit may continue to increase until it pushes the eye completely out of its socket, not only filling the whole cavity, but encroaching more or less extensively upon the cheek and cranium. In a similar manner a bony tumor may project into the pelvis, and materially impede the delivery of the child. An exostosis of a rib may compress the lungs; of a vertebra, the spinal cord; of the cranium, the brain. Another effect which such a tumor produces is to stretch, flatten, and displace the muscles, tendons, nerves, and vessels, thereby partially disqualifying them for the exercise of their functions.

Sometimes the coverings of the tumor are invaded by ulceration and even gangrene, thereby more or less freely exposing its surface, which occasionally, in its turn, takes on the same kind of action. At other times the morbid mass perishes, apparently from the want of nourishment, and is detached very much in the same manner as a slough of the soft parts. Exostoses of immense volume occasionally experience such a fate. The occurrence will be most likely to happen when the tumor has a narrow, cartilaginous base.

Diagnosis.—The diagnosis of exostosis cannot always be easily determined unless the tumor is situated superficially, when its great firmness and immobility will generally serve to point out its true character without any difficulty. When the tumor occupies some internal cavity, its nature may be suspected, but no surgeon, however skilled in the art of discrimination, can positively say to what class of growths it really belongs. Besides, an exostosis may sometimes seriously interfere with the diagnosis of other affections. Thus, a tumor of this kind, occupying the pelvic cavity, may impinge against the bladder, or even project into it, in such a manner as that the sound, coming in contact with its surface, shall impart a noise and sensation similar to those communicated by the presence of a calculus.

Prognosis.—The prognosis of this complaint varies. So long as the tumor remains small and indolent, it may commonly be considered as of little consequence; but when it increases rapidly, or is so situated as to interfere with the functions of a joint, or to encroach upon an important organ, it becomes a matter of serious import; the more so, because it is then not always possible to get rid of it by an operation, and there is generally nothing else that can reach it. When an exostosis projects into a joint, an operation becomes a hazardous undertaking, liable to be followed by the worst results; and when it occupies an internal cavity it is generally utterly inaccessible. An exostosis of the inner surface of the cranium usually proves dangerous by determining epilepsy, paralysis, and other bad symptoms; in the pelvis it may, as already stated, interfere with parturition, and in almost any part of the body it may induce neuralgia.

Treatment.—The treatment of exostosis must be guided, in great degree, at least in the earlier stages of the disease, before the tumor has acquired any considerable bulk, by the nature of the exciting cause, and hence special inquiry should always be made with reference to this particular point. When there is reason to believe that the affection has been occasioned by a deranged state of the system, or induced by the action of the rheumatic, gouty, or syphilitic poison, colchicum, aconite, and iodide of potassium, either alone, or in conjunction with bichloride of mercury, will be indicated, and can hardly fail, if judiciously administered, to prove highly beneficial. Under the influence of these remedies the growth of the tumor is often promptly arrested, and ultimately even entirely dispersed. The use of mercury is particularly serviceable in these cases, but to produce its full effects it is generally necessary to carry it to the extent of gentle ptyalism, maintained for some time, especially in obstinate cases. When the complaint gives rise to much pain, opium, conjoined with diaphoretics, will be required.

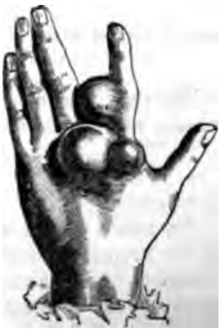
Topical applications are particularly useful when the tumor is of rapid growth, exquisitely sensitive, and the result of external injury, or of a syphilitic taint of the system. In the earlier stages of the disease, the remedies most to be relied upon are leeches, blisters, saturnine lotions, and the tincture of iodine, employed in the ordinary way. If blisters be used, and my experience is that they are generally the most valuable of all topical means, the skin over the tumor should be raised very thoroughly, and a free discharge should afterwards be maintained by some stimulating unguent, the object being to excite a permanent pyogenic effect. In the syphilitic form of exostosis, mercurial fumigation sometimes answers a good purpose, succeeding when all other remedies fail.

When the tumor has attained considerable bulk, and, above all, when it is of long standing, and of great firmness, or productive of excessive suffering, the only chance of relief is ablation, or, if this be impracticable on account of the nature and extent of the exostosis, amputation of the affected limb. The incisions through the integuments are made as in cases of ordinary growths, the most eligible shape being the crucial, elliptical, or T-like. Free exposure is effected, and in doing this care is taken not to interfere with any important structures, the division of which might afterwards impair the usefulness of the parts. If the skin is diseased, or much attenuated, the affected portion is, of course, removed. The exostosis is then attacked with the knife and a common metacarpal saw, the former alone, if stout, being commonly sufficient to effect ablation when the tumor has a cartilaginous base, or an unusually soft structure. In general, however, the saw will be necessary, and there are many cases where the gouge, chisel, and trephine may advantageously be employed. If the tumor has a very large base, and is insensibly confounded with the substance of the bone from which it grows, it should be divided into several sections, by perforating it at different points, and then detaching them separately, or piecemeal. Various kinds of saws have been invented for removing exostoses, but they are all more or less complicated and unwieldy, and may well be replaced by the more simple instruments in common use. In whatever manner the ablation be effected, there is one circumstance which should claim special attention, and that is to make the bony wound as smooth as possible by means of the raspatory, otherwise the rough surface will serve as a serious obstacle to cicatrization. As it is, there will, in any event, be more or less suppuration, retarding the progress of the case, and the patient may congratulate himself if he escape erysipelas and other serious consequences. The hemorrhage attending the operation is usually very slight. The edges of the wound should be lightly approximated, and the parts kept constantly wet with water-dressing, either cold, cool, or tepid, according to the exigencies of each particular case.

2. FIBRO-CARTILAGINOUS TUMORS.

The fibro-cartilaginous tumor, the *enchondroma* of recent writers, depicted in fig. 311, may be developed in the cancellated structure, or upon the outer surface of the bones, beneath the periosteum. Its figure is globular; its surface rough, or nodulated; its consistence firm, dense, and elastic; its color white, or grayish. When boiled, it yields a peculiar form of gelatin, termed *chondrin*. The tumor is essentially composed of a fibrous and of a cartilaginous substance. The former constitutes the nidus in which the latter is deposited, and consists of a vast number of oblong or rounded cells, from the size of a clover-seed to that of a pea. These cavities cannot generally be distinguished until the cartilaginous element has been scraped away, or removed by maceration. The morbid mass is strikingly conglomerate, and often attains a large

Fig. 311.

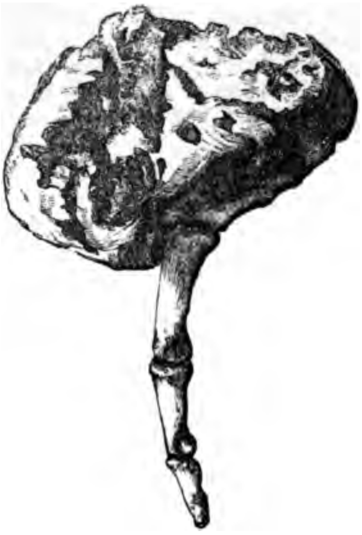


Fibro-cartilaginous tumors of the hand.

bulk. When it originates, as it commonly does, in the central part of the bone, it gradually encroaches upon the compact tissue, which it expands into a thin, porous shell, either entirely osseous, or partly osseous and partly cartilaginous. Finally, the attenuated lamella gives way at one or more points, and thus allows the morbid growth to protrude beneath the periosteum, which is itself often very much altered in its character.

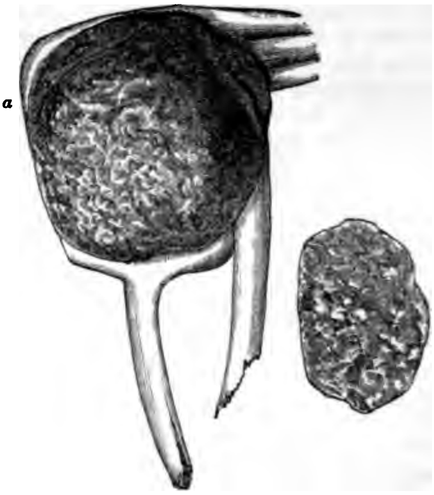
This tumor ordinarily affects only one bone, is not malignant, and is productive of little inconvenience, except from its size. It is peculiar to early life, is often directly chargeable to external violence, manifests no tendency to degeneration, not even when of long standing, is generally slow in its progress, and occasionally appears simultaneously in several parts of the skeleton. Every portion of the osseous system is liable to it; but the pieces most frequently affected are the metacarpal bones, the phalanges of the fingers, the humerus, and the lower jaw. To the tumor now described, especially when it is hard, fibrous, and interspersed with the *débris* of osseous matter, or red and dense, like half-boiled beef, or fresh pork, the unmeaning title of *osteosarcoma* is usually applied by surgical writers. When the disease is of long standing, the growth sometimes undergoes partial ossification, as in the specimen represented in fig. 312. Fig. 313 exhibits a fibro-cartilaginous tumor of the ribs, from a drawing of a preparation in my collection.

Fig. 312.



Enchondromatous tumor undergoing ossification.

Fig. 313.



Enchondromatous tumor of the ribs. *a.* External appearance. *b.* Internal structure.

The only remedy for this affection is free excision. All local and general means, even in its earlier stages, are unavailing.

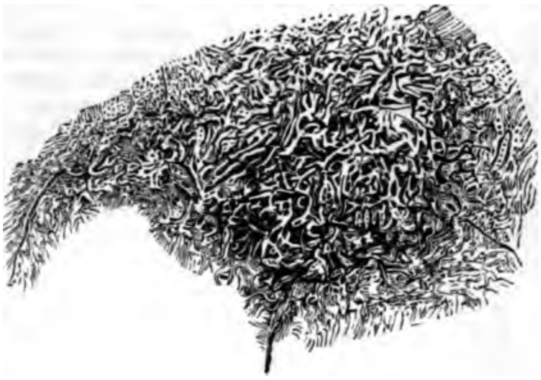
3. ANEURISMAL TUMORS.

Aneurism of the osseous tissue consists in an extraordinary development of the minute vessels, and presents precisely the same anatomical features as aneurism by anastomosis of the soft parts. Confined usually to one bone, it may occur in several, or even in a considerable number. In one case it was discovered in the cranium, sternum, ribs, vertebræ, and innominate bone of the same subject. Its favorite seat is the upper extremity of the tibia, just below the knee. It may arise at various periods of life, but is most common in young adults. The tumor varies in volume from a pullet's egg to a cocoa-nut.

The disease always begins in the cancellated structure, which is converted into chambers of various sizes, filled with coagulated blood, disposed in concentric layers, as in old aneurismal tumors. Some of the cells occasionally contain fluid blood, or blood partly fluid and partly clotted; but this is rare. The outer table of the bone is expanded, attenuated, and perforated, or so soft, flexible, and elastic that it may be bent like cartilage. In some instances, on the other hand, it is remarkably brittle, and may be crushed like the shell of an egg. The periosteum is thickened and indurated; but the joints in the immediate vicinity of the disease are commonly healthy, even when they are separated from it merely by a thin layer of cartilage. The vessels which ramify through the substance of the bone are tortuous, brittle, increased in size, and open by numerous little orifices into the aneurismal sac at various points of its extent.

There is a form of this affection in which the vessels, as was first clearly shown by Mr. Stanley, consist principally of enlarged capillaries, exhibiting the same general characters as an anastomotic aneurism or an erectile tumor of the soft parts. The disease, represented in fig. 314, has hitherto been chiefly noticed in the broad bones, especially those of the cranium, of young children.

Fig. 314.



Anastomotic aneurism of bone.

The causes of this lesion are involved in obscurity. In some instances it has been traced to the effects of a blow; in others, to a fall, or jump from a considerable height. Either of these occurrences, by disturbing the vascular action of the bone, might produce the disease.

The enlargement, even in its early stage, is tense and painful; being attended with distension of the superficial veins, swelling of the surrounding structures, and slight discoloration of the skin. In a short time a deep-seated pulsation, or throbbing, synchronous with that of the left ventricle, and similar to what is witnessed in some erectile tumors, may be perceived in the affected part. In the advanced stage of the malady the beating is accompanied by a sort of undulating movement, and is easily interrupted by compressing the main artery of the limb between the tumor and the heart. The enlargement varies in size. In a case mentioned by Mr. Bell, it was more than nineteen inches in circumference, by upwards of six in length. In some instances, pressure applied to the tumor with the finger imparts a peculiar crackling sensation, not unlike that of dry parchment or an egg-shell. The soft parts around the disease are generally œdematous, the whole limb is apt to be swollen, and the motion of the contiguous joints is constrained and painful. Towards the last the general health always seriously suffers.

The only effectual remedy for this disease, provided its location be favorable, is amputation. In the early stage relief may possibly be afforded by securing the main artery of the limb. Lallemand relates a case in which ligature of the femoral artery completely arrested an aneurismal affection of the head of the tibia; but this must be regarded as an exception to the general rule.

The anastomotic form of this disease admits of removal only when it is of limited extent. When it is situated in the cranial bones, it gradually destroys the osseous tissue, and ultimately involves the brain and its envelops, rendering interference out of the question. Several cases have been reported in which the carotid arteries were tied for this disease, but in none with any permanent benefit.

4. HEMATOID TUMORS.

There is a variety of tumors, closely allied to that just described, which, for the sake of uniformity in medical nomenclature, I shall term hematoid. It is produced by a deposition of blood in the cancellated structure, forming a firm, oval, and elastic tumor, filled with dark, solid coagula. The best specimen of this disease that I have met with, occurred to me, about ten years ago, in a man aged thirty-five, a portion of whose lower jaw I amputated, on account of what was supposed to be a bony tumor. The growth, which was about the size of a common orange, extended from the canine tooth on the right side to the middle grinder of the left, and consisted of a mere osseous shell, without any vestige of the cancellated structure; it was occupied by three red, solid coagula, the largest of which did not exceed the volume of a pigeon's egg. The cavity was only partially filled by the clotted blood, which adhered to the inner surface of the bony wall, and was evidently organized. The tumor had appeared three years before without any assignable cause. Whence was this blood derived? Did it proceed from a rupture of some of the vessels of the bone? If so, the fact could not be ascertained by the most careful examination.

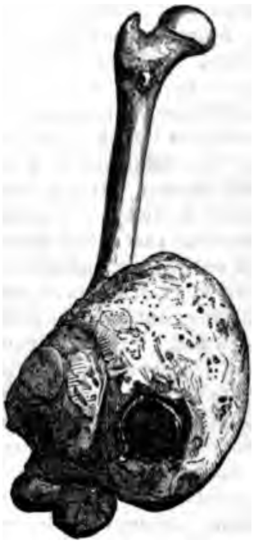
5. SERO-CYSTIC TUMORS.

Serous cysts, similar to those which occur in the soft parts, especially the ovary, kidney, and liver, are occasionally met with in various pieces of the skeleton, particularly in the lower jaw, the tibia, and femur. They are always developed in the areolar tissue, and show themselves in two distinct forms, the unilocular and multilocular, of which the first is by far the more frequent, the other being, in fact, extremely uncommon. Pathologists failed, until recently, to seize the distinctive features of this disease, and to assign to it a proper place in their nosological tables. Mention, it is true, was made of it by some of the authors of the last century, especially by Bordenave, but it was only in an incidental manner, and it remained for Dupuytren to furnish the first clear account of it. It is more than probable that what the older surgeons were in the habit of calling osteosarcoma and spina ventosa were frequently, if not generally, growths of this description, with cavities filled with liquid or solid matter. I have certainly commonly found them so, and it may, therefore, be concluded, that the same thing has happened to others.

Morbid Anatomy.—The unilocular cyst varies in size from that of a hempseed to that of a pullet's egg, its shape being generally irregularly rounded, or somewhat globular. It consists essentially of a thin, delicate, polished membrane, having, apparently, all the characteristics of the serous tissue. This membrane is closely adherent to the bony wall of the cyst, and undergoes important changes in consequence of age, and repeated attacks of inflammation, becoming dense, thick, opaque, and tough. The contents of the cyst are variable: sometimes clear and limpid, like well water; sometimes cloudy, ropy, or glutinous; sometimes sero-purulent; and finally, again, though this is uncommon, thin and discolored, from the admixture of hematin. Some of the older cavities occasionally contain solid matter, of an albuminous, curdy, or fibrous nature; and I have seen specimens in which they were occupied by a peculiar, micaceous-looking substance, not unlike cholesterine.

The multilocular cyst, represented in fig. 315, is less frequent than the unilocular. As the name imports, it is composed of a greater or less number of cells, divided by bony septa, and lined by a serous membrane, similar to that in the unilocular cyst, of which the multilocular appears to be merely an exaggerated variety. Its contents are generally of a sero-sanguinolent character, although sometimes they are clear and purely serous, like those of hydrocele. In one case, I found it thick and red, like the dregs of claret wine. In a group of multilocular cysts, a few will occasionally be seen to be filled with solid matter, or matter partly solid and partly fluid. When this is the case, it may generally be assumed that the cysts are old, and that their vessels have undergone important changes in their secretory action, in consequence of which they pour out concrete instead of liquid substance. I have witnessed instances, however, in which the material was of such a nature as to induce the belief that it was originally deposited in a solid form. However this may be, the substance is generally of a fibrous or fibro-cartilaginous character, and so firmly adherent to the walls of the cysts which contain it as to be with difficulty enucleated. Interspersed through this substance are occasionally little nodules, fragments or spicules of bone, and earthy concretions, or a combination of calcareous with osseous matter.

Fig. 315.



Cystic disease of the femur.

Age and Sex.—Serous cysts of the bones are most common in young adults and middle-aged subjects; being seldom met with before puberty, or after fifty. Both sexes are liable to them, but in what proportion, has not been determined. Their causes are involved in obscurity. In general the disease arises spontaneously. In the lower jaw, which, as has already been stated, is its most frequent seat, its origin is often ascribed to the irritation of a decayed fang, or to violence done in the extraction of a tooth; but before we can admit the influence of either as a cause of serous cysts, it must be remembered that thousands of persons constantly suffer in this way, without any such occurrence, and hence the development of these bodies may, after all, under such circumstances, be a mere coincidence. So, also, with respect to blows, fractures, contusions, and other mechanical injury, so often invoked as sources of this and other organic maladies of the bones. If they are really capable of producing such an effect in one case, why should they not in another? We must, therefore, look beyond these causes, and conclude that some other agent is concerned in their origin, although of the nature of that agent we are entirely ignorant.

Progress.—The progress of this disease is always slow. In the jaw we often meet with cases of serous cysts of six, twelve, and even fifteen years' standing, without any serious disturbance of the general health, or any particular local disorder, save what results from the pressure of the tumor upon the surrounding structures. Neither the cysts, their fibrous contents, nor the parts adjacent manifest any tendency to malignancy, and I am inclined to believe that whenever such an occurrence is observed it is to be received as a strong evidence that the growth was originally of a bad character, and not that it became so in consequence of any new epigenesis. When the tumor is large, whether it be multilocular or not, fluid or solid, it generally exhibits a marked tendency to destroy the bone in which it is located, pressing aside the compact lamella, and gradually involving its entire circumference. In the lower jaw the parts most commonly affected are the body and ramus, extending often beyond the middle line in front, and backwards as far as the condyloid process.

Symptoms.—The symptoms of cystic disease of the osseous tissue are obscure. The first thing that usually attracts attention is a dull aching pain, in some particular bone, as, for example, the jaw, which is often mistaken for toothache, or rheumatism; this gradually increases in severity and frequency, and is at length found to be dependent upon the presence of a hard tumor, or the expansion of a portion of the bone, more or less tender on pressure and motion, but unattended by any discoloration or intumescence of the overlying textures. The progress of the disease is always tardy, and it often happens that, after having attained considerable development, it remains, to all outward appearance, for some time perfectly stationary. Then, taking a new start, it again increases, and thus it continues, now advancing and now halting, until it has perhaps acquired the volume of a large orange, or even of a fist. Still, the general health continues good, there is no emaciation, and the countenance is perfectly free from that distressed, anxious, and sallow state which characterizes it in malignant disease. Even the pain is generally comparatively trivial, and if it were not for the mechanical obstruction occasioned by the encroachment of the tumor upon the adjacent parts, the patient would hardly be conscious of being unwell. If the parts be now carefully examined, they will be found to be of unequal consistence, the firmer parts being incompressible, while the softer ones readily yield under the finger, emitting a peculiar crackling noise not unlike that of dry parchment. In the absence of signs of malignancy, pulsation, lividity, and varicose enlargement of the overlying vessels, these circumstances afford the best evidence of the true nature of the disease, but if there be any doubt respecting it, this may generally be promptly dispelled by a resort to the exploring needle, the escape of serous, or sero-sanguinolent fluid determining the diagnosis. The tardy growth of the tumor and the absence of constitutional disorder are, indeed, commonly of themselves sufficient to mark the character of the malady. Between cystic and hydatic diseases of the bones no signs of distinction exist, nor is this a matter of importance, as the treatment is essentially similar.

Treatment.—The only available treatment in cystic disease is removal of the morbid mass, and some of the most brilliant exploits in modern surgery have been performed upon tumors of this kind. When it involves the jaw, the greater portion of that bone sometimes requires excision, the affected part being cut away along with a portion of the sound tissue, the same principle guiding the surgeon as in the extirpation of morbid growths of the soft structures. When the cysts are small and not numerous, they may sometimes be effectually scooped out, the cavity being afterwards stuffed with lint, and made to heal by the granulating process. On the other hand, cases occur, as when the disease involves the entire circumference of one of the bones of the extremities, where, neither of these procedures being avaliable, nothing short of amputation will answer.

I am aware that various plans of treatment have been suggested for arresting this disease in its earlier stages, or curing it without the knife when it has attained a considerable magnitude. So far, however, as I am informed, there are none which are entitled to any confidence. The most plausible of these are iodine injections and the introduction of the seton; the former of which experience has proved to be ineffectual, while the latter is so unscientific as not to be thought of, much less practised, in any case.

6. HYDATIC TUMORS.

One of the most remarkable diseases of the bones is the development of hydatids in their spongy structure, an occurrence which, although uncommon, has now been so repeatedly observed as to entitle it to distinct notice in a systematic treatise on surgery. The first account of these bodies was given by two Dutch pathologists, Van Vy and Vander Haar. Since then attention has been directed to them by other observers, who, minutely detailing the facts which have come under their notice, have thus laid the foundation of our knowledge of this interesting subject.

Although it is extremely probable that all the different classes of bones are liable to these formations, yet they have hitherto been observed almost exclusively in the long and flat bones, particularly in the tibia, for which, judging from the frequency of their occurrence here, they appear to have a sort of preference. They have been found three times in the frontal bone, twice in the iliac bone, twice in the humerus, once in the femur, and once in a vertebra. What was formerly known under the vague name of spina ventosa was an osseous tumor which probably occasionally contained bodies of this kind.

Situation.—Hydatids of the bones are always developed in the spongy texture of the skeleton, as this alone affords them an opportunity of growing and expanding, the compact tissue being too dense and firm to admit of their increase. The only exception to this occurs when they form in the frontal sinus, but even here there is, it will be observed, no new law in operation, since the cavity in question is, in fact, only a large cell, exceedingly well adapted as a residence for such creatures. In the tibia, the disease is always situated in the spongy structure which exists in such abundance in the head of this bone, just below the knee.

How these bodies are developed is still a mystery. That the germs are conveyed to the spongy tissue of the bones in the blood which is sent to them for their nutrition and growth is evident enough, but why they should be deposited here in preference to other parts of the body is a question which the most refined pathology is unable to answer. Nor is anything certainly known in regard to the nature of the exciting causes of these bodies; for if, as has occasionally happened, they have shown themselves in a particular portion of the skeleton after the occurrence of a blow, contusion, or other injury, it does not prove that their development was the consequence of such injury.

Sex does not appear to exercise any particular influence upon the development of hydatids of the bones, as they have been observed with nearly equal frequency in men and women. Most of the patients in which they have hitherto been found were adults, but in one instance they occurred in a child three years of age. Borchard has narrated a case where they existed in several situations in the same individual.

Morbid Anatomy.—Examination has proved that these bodies are really acephalocysts, similar to those which are occasionally met with in the liver, ovaries, lungs, and other internal viscera. Of a spherical or rounded shape, they are sometimes irregularly flattened, or compressed, and vary in size from that of a pea to that of a marble, their dimensions being evidently influenced by their age, and the extent of the cavity in which they are developed. Their number, which is seldom large, is usually in an inverse ratio to their volume. They are inclosed in a sort of parent-cyst, soft in structure, thin, and of a whitish appearance, and they float about in the midst of a serous fluid, of a saline taste, and partially coagulable by heat, alcohol, and acids, circumstances clearly betraying its albuminous character.

The cavity in which these bodies are situated is deserving of special attention. It is evidently, in the first instance, simply one of the cells of the areolar tissue, in which the germ of the animal is deposited, and where it is destined afterwards to attain its full development. As its growth proceeds, it presses upon the osseous matter, pushing its fibres farther and farther apart, at the same time causing a partial removal of it by the action of the absorbents, until what remains is at length converted into a mere bony sheet, hardly as thick as a piece of parchment, elastic, and crackling under the finger. The shell is lined, as already stated, by a thin, closely adherent membrane, which evidently plays an important part in the development and protection of the new being. Cases occur in which it consists of several compartments, cells, or lodges, although in general it is unilocular. The bone immediately adjacent to the disease is usually thickened and roughened by irregular deposits.

Symptoms.—The symptoms attending the formation of these bodies are extremely obscure, and cannot, for a long time, be separated from those which accompany other diseases in and about the skeleton. Their growth is always very tardy, and a long time elapses before there is any pain and discoloration of the integuments. The patient is merely aware that there is some tumor, gradually augmenting in bulk, and slowly encroaching upon the surrounding parts; hard and firm at first, afterwards more soft, and ultimately becoming quite elastic, and emitting a peculiar crackling sound on pressure very similar to that of dry parchment. If it be deep-seated, it will cause a gradual wasting of the superimposed tissues, the muscles and tendons being spread out like thin ribbons, while portions of the fibrous membranes are actually absorbed. Meanwhile, the tumor mechanically impedes the functions of the surrounding parts, pain and tenderness set in, and the integuments show signs of irritation and discomfort. At this stage of the complaint the affected bone sometimes gives way under the most trivial accident, refusing afterwards to unite, or undergoing consolidation only after a long while and after much trouble. Occasionally, the most prominent portion of the tumor ulcerates, and discharges a part of its contents; such an event, however, is extremely rare. The general health remains good for years, but in the end it is always much impaired in consequence of the local distress.

Diagnosis.—The most important diagnostic signs are, the tardy progress of the tumor, the want of pain and swelling, the change from a hard, incompressible substance to one of comparative softness and even elasticity, and the complete absence of all appearance, both local and constitutional, of malignancy. After all, however, these symptoms are merely of a negative character; for at last the only reliable source of information is the exploring needle, though this also, unfortunately, is not available until the morbid growth has acquired a great bulk, and is almost on the verge of bursting. Even the elastic feel and crackling noise which, in the latter stages of the complaint, form such prominent features, are of no diagnostic avail, as they are common to several other varieties of bony tumors.

Prognosis.—Hydatic disease of the osseous tissue is always a grave occurrence, not so much on account of the damage it does to the general health as on account of the injury it inflicts upon the affected bone, weakening its structure, and thus impairing its usefulness, generally to an irremediable extent. In several of the recorded cases the acephalocysts burst into the knee-joint, causing violent suppuration, and destruction of the functions of the articulation. In a few others, the animals perished, and shrunk up into dirty, reddish-looking masses, which afterwards became a source of irritation, followed by high constitutional disturbance, excessive pain, and hectic fever.

Treatment.—The only remedy that can at all reach this disease is extirpation, and the earlier this is performed the better, for then there is no serious structural lesion of the bone, involving the necessity of resection or amputation. As soon, therefore, as the diagnosis is fully established, the tumor should be freely exposed by an incision, either crucial or elliptical, and attacked with the saw, pliers, trephine, or chisel and mallet, as may seem advisable. Its contents being turned out, the lining membrane of the osseous shell is carefully peeled off, or, when this is impracticable, painted with a strong solution of iodine, to destroy its secreting surface, lest there should be a speedy reproduction, if not of hydatids, at all events of serous fluid. The cavity is then filled with lint, smeared with cerate, and the flaps being approximated are lightly held in place with a few strips of adhesive plaster. The cavity will gradually shrink, and a cure be effected by the granulating process.

When the case is one of an aggravated nature, involving the entire circumference of the affected bone, or when the hydatids open into a joint, the only question will be whether the treatment shall be by resection or amputation. The former procedure can only be suitable when the disease is of limited extent; and in that event, it may probably always be replaced by excision, so that, in reality, it would be difficult to imagine how or when it could be of service. Amputation will be necessary when the case is desperate, as when the bone is irremediably destroyed, or broken and unwilling to unite, or when the tumor has discharged its contents into a neighboring articulation, and has induced so much disturbance, local and constitutional, as to threaten life.

7. MYELOID TUMORS.

The osseous tissue is more liable to the myeloid tumor than any other class of textures, and it is here that the new structure generally acquires its most perfect development. Doubtless it may occur in all, or nearly all, the pieces of the skeleton, but its favorite sites would seem to be the tibia, femur, and inferior maxilla, especially the latter. Commencing generally, if not always, in the cancellated structure, its point of departure is probably the endosteum, extending from thence to the compact layers, which it gradually disparts, and converts into thin, cartilaginous plates, bending and crackling under the finger like dry parchment. Continuing its growth, it may, in time, attain the size of a fist, or even of a fœtal head, encroaching seriously upon the surrounding parts, and interfering, more or less, with the exercise of their functions. The arteries leading to it are generally somewhat enlarged, and the tumor itself is commonly quite vascular. A section of it exhibits a smooth, compact appearance, of a reddish, pink, or lilac tint, inlaid, as it were, with soft bony fibres, and pervaded by little cysts, either simple or compound, and occupied by different kinds of fluids, as serum, sanguinolent matter, or altered blood, or all these substances commingled.

There are no *signs* by which this growth can be distinguished from other tumors of the bones; its rapid development, its elastic feel, and its lobulated form assimilate it very much, in its external characters, to encephaloid, and the resemblance is still further shown by the fact that the disease is liable to recur after extirpation, and also that, in its advanced stages, the patient presents all the evidences of the cancerous cachexia. The only remedy is excision or amputation; excision, when the tumor involves the jaws, amputation, when it is seated in the bones of the extremities.

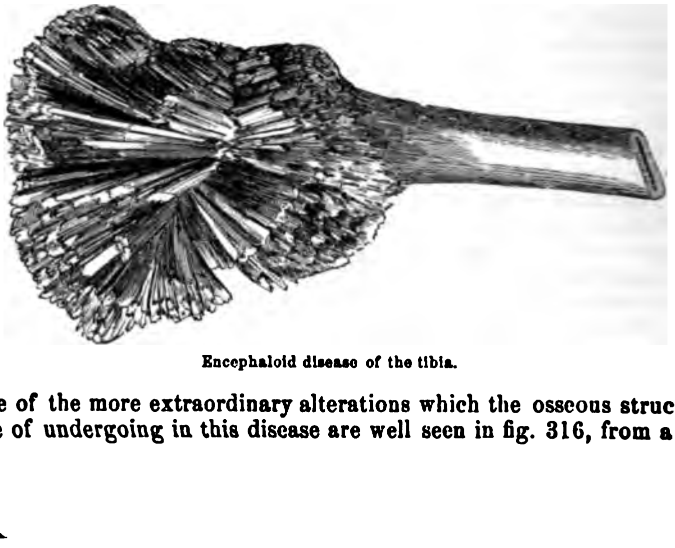
MALIGNANT FORMATIONS.

The various malignant affections of the bones may, as far as practical purposes are concerned, be all conveniently grouped under one head. Of these affections, encephaloid is much the most common; next in point of frequency is colloid, then comes scirrhus, and finally, as the most rare of all, melanosis. The origin, progress, and termination of these formations are the same here as in other organs and tissues.

1. *Encephaloid*, hematoid fungus, cerebriform cancer, or osteocephaloma, generally, if not invariably, originates in the spongy structure of the bones, from which it gradually extends to the compact lamella, and finally to the periosteum. It most commonly attacks the upper and lower jaw, and the long bones of the extremities, particularly the femur, humerus, and digital phalanges. No portion of the skeleton, however, is exempt from it. The most terrific feature of the encephaloid is its tendency to recur in some other part of the body, after it has been dislodged from its original situation. It may show itself at any period of life, but young persons are most prone to it.

Although encephaloid may occur as an infiltration, it most commonly presents itself in the form of a tumor, arranged in rounded, lobulated masses, of the color and consistence of the medullary structure of the brain. Not unfrequently it contains small cavities, filled with clotted blood, dirty looking serum, or soft, gelatinous, oily, sebaceous, or melliceroid matter. Occasionally one part of the tumor exhibits the brain-like character, while another is strictly hematoid, or composed of a mixture of blood and encephaloid. In the great majority of cases, however, the two substances are pretty intimately blended together. Vessels, sometimes of considerable volume, may be seen ramifying over the surface of the morbid growth, and dipping into its interior. The outer table of the bone is transformed into a thin, parchment-like lamella, perforated in various places, or entirely destroyed by absorption. A section of the tumor usually exhibits, in addition to the appearance just described, osseous fragments, or pieces of fibro-cartilage. The superincumbent integuments, traversed by large bluish veins, are at first soft and glossy; but at length, from the constant and increasing pressure exerted upon them, they ulcerate, and allow the fungous mass to protrude.

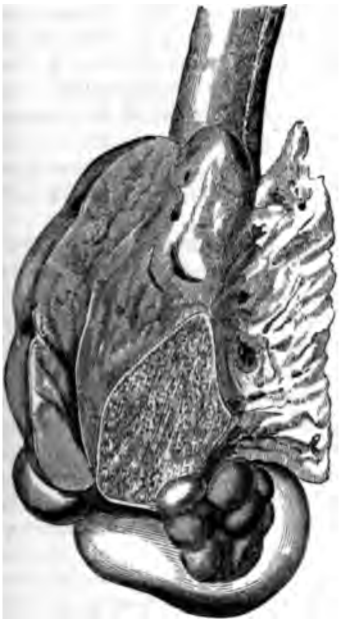
Fig. 316.



Encephaloid disease of the tibia.

Some of the more extraordinary alterations which the osseous structure is capable of undergoing in this disease are well seen in fig. 316, from a specimen in the cabinet of Professor Buchanan. The patient was a mulatto girl, about twelve years of age, who had labored for some time under a large, lobulated tumor, partly elastic and partly inelastic, situated in the lower part of the leg, and attended with great dilatation and distension of the subcutaneous veins. Amputation being performed, the stump healed kindly, and for several weeks the girl did well: but in a few months she began to complain of pain in her hip and side, and she died in less than a year, apparently from internal malignant disease. A section of the tumor displayed an immense number of osseous spicules, of extraordinary length and delicacy, whose intervals were occupied partly by cartilaginous and partly by gelatinous substance, with here and there a cyst containing bloody-looking matter. The external characters of encephaloid are well displayed in the adjoining cut, fig. 317, from a specimen in my collection.

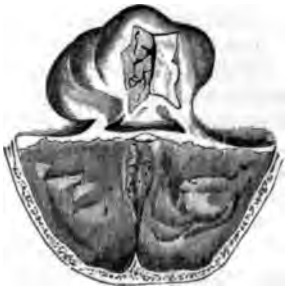
Fig. 317.



Encephaloid disease of the thigh-bone.

2. Of *colloid* of the osseous tissue very little is known. It is most frequently met with in the diseased conditions of the bones denominated osteosarcoma and spina ventosa, which are often almost wholly composed of cells and cavities, filled with jelly-like matter. The question, however, respecting the identity of these affections can be determined only by future observation. A case in which a colloid tumor grew from the body of the sphenoid bone, outside the dura mater, came under my notice in 1844, in the medical ward at the Louisville Hospital. The patient died at the age of thirty-nine years from epilepsy, produced by a fall twelve months previously. On examination, Dr. Colescott and myself found, in the situation referred to, a lobulated tumor, of irregular form, and about the size of a pullet's egg, which had flattened the Varolian bridge, and evidently induced the disease in question. A section of the morbid mass, fig. 318, showed that it was composed of several compartments communicating with each other, and occupied by a white, semi-concrete substance, in all respects similar to that of colloid.

Fig. 318.



Colloid tumor.

3. *Scirrhus* of the osseous tissue is extremely uncommon. It occurs exclusively in old subjects, and is usually concomitant of the same disease in the breast or some other organ. Generally limited to a single bone, it may affect several pieces simultaneously, and always begins in the cancellated structure. Its favorite seat is the femur, but it may appear in any part of the skeleton, in the short and flat bones, as well as in the long.

The heteroclite matter is deposited under two varieties of form, the infiltrated, and the tuberoid. In the former it is diffused through the areolar tissue, and exhibits the color and consistence of fibro-cartilage, or the rind of fresh pork. In the tuberoid variety the morbid mass is either solitary, or it consists of several agglomerated nodules, from the volume of a hazel-nut to that of an almond. Occasionally three or four distinct tumors are developed simultaneously in the same bone. They are of an irregularly rounded or oval shape, dense and firm in their consistence, and of a greenish, whitish, or yellowish color. The bone is seldom much altered in its size or external configuration, but is liable to be absorbed, and fractured at the seat of the disease.

4. The occurrence of *melanosis* in bone is very infrequent. It may appear in small, disseminated masses, nodules, or clusters, or in the form of an infiltration. It has been observed in various parts of the skeleton, but is most common in the pieces of the extremities, particularly the femur and tibia. Co-existing generally with melanosis in other organs, it is situated either upon the surface of the bone, beneath the periosteum, in the medullary canal, or in the spongy structure, the latter of which it sometimes dyes of a deep black color. In its progress and mode of termination it closely resembles medullary sarcoma.

General Diagnosis, Prognosis, and Treatment.—Much has been said, especially of late years, respecting the diagnosis of cancerous diseases of the osseous tissue, and from reading the accounts of these formations in the books one would suppose that their recognition was a matter of the greatest facility. Nothing, however, is more untrue. With the exception of encephaloid, it is extremely difficult to detect the real nature of any of them during any portion of their progress, and even encephaloid cannot always be satisfactorily discriminated until it has acquired an unusual bulk. In the latter case, the most reliable guides are, the early period of life at which the tumor shows itself, the rapidity of its growth, the great bulk it attains, the depth of its situation at the commencement of its development, the lobulated condition of its surface, and the extraordinary enlargement of the subcutaneous veins. In general, too, it will be found that the disease is developed in one of the long bones, as the humerus, femur, or tibia, and in preference, as it were, in their articular extremities. The moment ulceration occurs the case speaks for itself, the diagnosis being no longer equivocal.

The progress of encephaloid is generally very rapid, especially when it occurs upon the periphery of the bones, a few months usually sufficing for the formation of an immense tumor, and the complete destruction of the osseous tissue, or its conversion into a soft, sarcomatous, or fibro-cartilaginous mass, with hardly any trace of the primitive structure. The growth is commonly of a lobulated character, and of varying degrees of consistence, being soft at one part, tolerably firm at another, and perhaps almost bony at a third, according to the nature of the portion examined. As it increases in size, it displaces the surrounding textures, flattening the muscles and nerves, and thus impairing their functions; the integuments are stretched, and, in places, attenuated; and the subcutaneous veins are enlarged, varicose, and of a bluish color. The colloid tumor is also capable of attaining a great bulk, but its progress is usually much more tardy than that of encephaloid, and there is seldom any considerable augmentation of the subcutaneous veins. Scirrhus of bone usually co-exists with scirrhus of the mammary gland, uterus, or liver, and the only symptom leading even to a suspicion of its existence is the peculiarity of the attendant pain, which is usually either sharp and lancinating, or else dull, heavy, or aching, and fixed in its position, the affected part being, at the same time, exquisitely tender on pressure and motion. The patient often becomes bedridden during the progress of the case, and the diseased bone not unfrequently gives way under the most trivial accident, as a mere twist of the limb in stepping out of the bed upon the floor. Melanosis of the osseous tissue is seldom discovered during life, unless it happen to be seated in a superficial bone, as the sternum, or one of the ribs; in nearly every instance that has yet been observed, it was present at the same time in other parts of the body.

Cancer of bone follows the same course as cancer of the soft parts. If left to itself, the malady inevitably proves fatal, and hardly any one makes a permanent recovery after an operation, however early and thoroughly executed. In all the cases of encephaloid of the extremities that I have either operated upon myself, or seen operated upon by others, there has been a speedy recurrence of disease, often indeed in less than three months, either at the cicatrice, the neighboring lymphatic ganglions, or in some internal organ, carrying off the .patient a short time afterwards. I am aware that exceptional cases are sometimes reported, but they are only exceptional, and nothing more, to say nothing of the fact that there may occasionally be in these cases an error in the diagnosis, the tumor, although possessing some of the outward properties of osteocephaloma, being in fact merely a benign one, appertaining to the osteosarcomatous class of the older writers. Judging from personal observation, I am inclined to believe that malignant growths of the maxillary bones are less liable to relapse after operation than those of any of the other pieces of the skeleton, and in this view of the subject, if I mistake not, the opinion of practitioners generally coincides. Nevertheless, even here the ultimate issue of the case is nearly always unfavorable. The circumstances justifying interference in this class of maladies, have already been so fully pointed out in the chapter on carcinomatous diseases generally, as to render any further discussion of them unnecessary in this place. In regard to the choice of the operation, as to whether this should be amputation or excision, the decision must always be given in favor of the former whenever the morbid growth occupies an extremity, the removal being effected as high up, or as near to the trunk, as possible, as conferring greater safety. Thus, when the hand is involved, the forearm should be cut off near the elbow, and in encephaloma of the radius and ulna, the limb should be amputated pretty close to the shoulder. If the tumor be seated in the upper jaw, the whole of that bone should be excised, together, perhaps, with portions of the palate, spongy, and malar bones. Thorough work must be made, or interference will be productive of infinite harm. After recovery from the operation, the patient must be put upon a properly regulated diet, with an alterative and tonic course of treatment, and exercise in the open air.

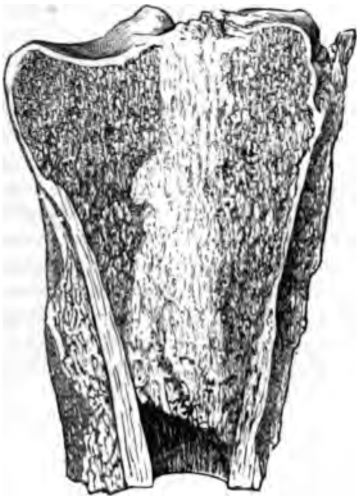
SECT. XIII.—TUBERCULAR DISEASE.

Tubercles of the bones are much more common than is generally imagined. The bones usually affected are the vertebræ, the short bones of the hand and foot, and the articulating extremities of the long bones. The particular seat of tubercles is the spongy texture, though occasionally they are formed upon the outer surface of the bones, between it and the periosteum.

There are two varieties of form in which this matter is deposited. In one, perhaps the more common, the tubercles are *encysted*, the inclosing membrane, which varies in thickness from the fifth of a line to half a line, being composed of coagulating lymph, very soft at first, but gradually becoming harder and harder, until finally, in some cases, it acquires the character of fibro-cartilage. It is of a dull grayish color, is made up of delicate, inelastic fibres crossing each other in every conceivable direction, and is frequently furnished with small vessels, passing into it from the surrounding structures. The number of tubercles is seldom very great; their size ranges from that of a pea to that of a nutmeg; and in most cases they present a yellowish, opaque appearance. When these bodies become softened, the matter will either work its way out, or pass, by a sort of fistulous route, into a neighboring joint, establishing thereby an analogy with pulmonary tubercles opening into the bronchial tubes. Sometimes a spontaneous cure takes place, the heterologous substance being absorbed, and the cyst contracting so as to obliterate its cavity.

In the second variety, the tubercular matter is deposited directly into the cells of the osseous tissue, forming grayish, semi-transparent, opaline patches, from the one-sixth of an inch to an inch in diameter. This *infiltration*, exhibited in fig. 319, is noticed chiefly in the bodies of the vertebræ and in the bones of the tarsus, where it is frequently pervaded by numerous vessels, too delicate to be discerned with the naked eye. The bony tissue immediately around is sometimes deeply injected, but seldom otherwise diseased. In this, as in the preceding variety, the tubercular deposit, after having existed for some time, gradually softens, its vascularity disappears, and the cells in which it was contained are filled with earthy matter. This, however, is not always the case; for now and then the ulcerative process continues until the bone is totally destroyed.

Fig. 319.



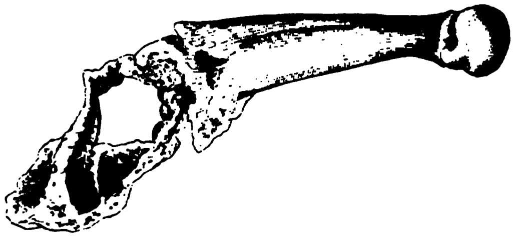
Section of bone infiltrated with tubercular matter.

The *progress* of tubercular disease of the bones is always chronic, though not equally so in both forms, the infiltrated proceeding more tardily than the encysted, and causing generally also a greater amount of havoc in the osseous tissue. No definite information, however, can be furnished in regard either to the commencement of the softening process, or to the ultimate elimination of the matter produced by that action, from the affected structures. Much will doubtless depend, in every case, upon the condition of the system, the age of the patient, and the presence or absence of local complications. As a general rule, from six to twelve months will elapse from the moment of the deposition of the tubercular substance to the completion of the softening process. The matter resulting from the disintegration of the heteromorphous deposit is similar to that which occurs in the lungs in the advanced stage of phthisis, being of a pale yellowish color, bordering slightly upon greenish, and of a thin fluid consistence, with small whitish flakes not unlike soft-boiled grains of rice. After an opening has been effected into the abscess, the discharge generally becomes very watery and bloody, as well as irritating, and comes away in large quantities, a number of sinuses often existing in the diseased parts, as if they were necessary to carry off the superabundant secretions. In many cases, broken-down osseous tissue is intermingled with the pus, passing off either as little granules or as minute fragments, which not unfrequently choke up the abnormal track, and thus excite new irritation.

The adjoining cut, fig. 320, from a specimen in my cabinet, exhibits the effects which a tubercular abscess may exert upon the osseous tissue, in causing a well-marked excavation, similar to what we see in the lungs.

The abscess that arises from the disintegration of the tubercular matter is the form which is usually met with in bone, the phlegmonous, as stated elsewhere, being of extremely rare occurrence. The symptoms attending it are generally obscure, but its existence may be suspected when, along with the ordinary signs of osteitis, the affected part is the seat of circumscribed, deep-seated, gnawing pain, with excessive tenderness at one particular spot, and a glossy, shining, œdematous condition of the integuments. The breaking of the abscess is always preceded by considerable swelling of the soft structures, and by more or less disturbance of the system, the constitution frequently sympathizing severely with the local trouble. In addition to these circumstances, the history of the case, as the age of the patient, the site of the morbid action, and the absence or co-existence of strumous disease in other structures, will generally furnish useful light, and thus materially aid in the establishment of a correct diagnosis.

Fig. 320.



Tubercular excavation of the cuneiform bone.

The *treatment* of tuberculosis of bone differs in no material respect from that of tuberculosis in the other organs and tissues. Bearing in mind the fact that the local deposit is, in general, merely a reflection of the state of the system, the judicious practitioner will not neglect the employment of such remedies as are necessary to modify this condition of the constitution and to provide for the supply of a better and richer blood. The principal means included under this head are, a well-regulated and adequately nutritious diet, cod-liver oil, and the various chalybeate preparations, either alone, or in union with quinine, mild purgatives, and gentle exercise in the open air, especially if the seat of the disease do not act interferingly.

The local remedies are, of course, of the ordinary antiphlogistic character, consisting of leeches, blisters, and the dilute tincture of iodine, with early and free incisions of the soft structures to relieve pain and tension. If the existence of an abscess is suspected, prompt recourse is had to the trephine, the operation and after-treatment being conducted upon the same principles as in acute or phlegmonous abscess of bone, already described.

SECT. XIV.—NEURALGIA.

Neuralgia of the osseous tissue is infrequent. I have seen a large number —perhaps it would be more correct to say an immense number—of cases of neuralgia of the soft structure in almost every part of the body, but only a few of neuralgia of the bones. In nearly every instance that has fallen under my observation the disease was associated with some organic lesion of the affected texture, such as abscess, caries, exostosis, or interstitial deposits into the Haversian canals and cancellated tissue, thereby compressing the vessels and the nerves distributed through their tunics. A lady, aged fifty, a personal friend of mine, had long been afflicted with neuralgia of the cranium, caused by the falling of a window-sash upon the upper and posterior angle of the left parietal bone. The pain, without observing any regularity in its accession, gradually increased in severity, and became at length so intense as to require from one to two drachms of morphia a week, besides enormous quantities of sulphuric ether, for even its temporary subjugation. The seat of pain was a small spot, not larger than the end of the finger, and exquisitely tender to the touch. A disk of bone, embracing the affected portion, being removed with the trephine, an exostosis, not more than the eighth of an inch in thickness, was discovered upon its inner surface, which thus at once explained the nature of the case, complete recovery following the operation.

A married woman, aged twenty-eight, had suffered, at times, most acute and distressing pain from a small bony tumor at the anterior and outer part of the lower extremity of the left radius. The tumor had come on about twelve years previously, and had all along been exquisitely sensitive on pressure and even on the slightest touch. It projected but little beyond the natural level, and was unaccompanied by any visible change in the soft parts. The pain had been liable to periodical exacerbations, and was often so severe as to deprive the woman of appetite and sleep. The general health was always good, the complexion denoting rather a robust state of the system, and the menstrual function being performed with great regularity. Upon removing the tumor, I found that its substance was almost of the consistence of ivory, offering great resistance to the instruments. The pain at once disappeared, and has never returned.

I have met with a number of cases similar to the last, which may be regarded as, in some degree, typical of this affection as it usually appears in the skeleton. Most of them occurred in young females, between the ages of twenty and thirty, without, seemingly, any direct connection with the catamenial function, which was usually well executed, and without any marked hysterical predisposition. In all the cases that I have met with, the pain was liable to periodical exacerbations, not, however, by any means always coincident with menstruation, and the parts were exquisitely sensitive under motion and pressure. The pieces which I have found most frequently affected were the radius, ulna, tibia, fibula, clavicle, and cranial bones, especially the frontal and occipital. In several instances I have known the coccyx to be the seat of neuralgia, the pain being so severe as to cause the greatest possible suffering. So far as my observation goes, the disease never attacks this bone except in married women who have borne children, and I presume that it depends here, as elsewhere, upon the presence of interstitial deposits, either as a simple hypertrophy, or a small exostosis, compressing the vessels and nerves of the osseous tissue.

Neuralgia of bone generally results from direct injury, as a blow, wound, or contusion, causing inflammation in the affected part, followed by a deposit of new osseous substance. It may also be produced by a syphilitic taint of the system, as we see in the tertiary form of this disease, in which the pains are not unfrequently of a darting, shooting, lancinating nature, or else dull, heavy, and aching, as in neuralgia of the soft structures. In abscess of bone the suffering is frequently of the same character, and hence the difficulty which the practitioner so often experiences in discriminating between the two affections. The disease is frequently associated with neuralgia in other parts of the body.

The *treatment* of neuralgia of bone is too often conducted upon empirical principles; a circumstance which is doubtless due to the fact that it is generally difficult, if not impossible, to ascertain the true nature of the disease. In recent cases, especially in such as are directly chargeable to the effects of external injury, a free incision down to the seat of the disease, dividing the periosteum and even the superficial layer of the bones, will occasionally effect a prompt cure, especially if the wound be kept open for some time with stimulating dressings to promote discharge. Now and then a small issue, made with the actual cautery, will answer an excellent purpose. When the cause is of a syphilitic nature, iodide of potassium and mercury afford the best means of relief. Quinine, arsenic, and strychnine are indicated when the disease is of miasmatic origin. In obstinate cases, the only reliable plan is removal of the affected bone with the trephine or other suitable instruments; the object being to get rid of the compressing agent, whether this be merely simple hypertrophy of the part or an exostosis, properly so-termed. Dr. Nott, of Mobile, has on two occasions excised the greater portion of the coccyx for the cure of this disease, but the results have not, I believe, been as satisfactory as had been anticipated.

SECT. XV.—FRACTURES.

1. GENERAL CONSIDERATIONS.

There is no class of injuries which a practitioner approaches with more doubt and misgiving than fractures, or one which demands a greater amount of ready knowledge, self-reliance, and consummate skill. Constant in their occurrence, and often extremely difficult of diagnosis and management, they frequently involve consequences hardly less serious and disastrous to the surgeon than to the patient himself. If I were called upon to testify under oath what branch of surgery I regarded as the most trying and difficult to practise successfully and creditably, I should unhesitatingly assert that it was that which relates to the present subject, and I am quite sure that every enlightened practitioner would concur with me in the justice of this opinion. I certainly know none which requires a more thorough knowledge of topographical anatomy, a nicer sense of discrimination, a calmer judgment, a more enlarged experience, or a greater share of vigilance and attention; in a word, none which requires a higher combination of surgical tact and power. As for myself, I never treat a case of fracture, however simple, without a feeling of the deepest anxiety in regard to its ultimate issue; I cannot retire at night or rise in the morning without a sense of discomfort, so long as I am conscious that, despite my most assiduous attention and my best directed efforts, my patient is likely to become deformed and lame for life. If this feeling were more general, it is easy to perceive that there would be comparatively few cripples from this cause, and comparatively few suits for malpractice, unfortunately so common, of late years, in this country, and so disreputable to the profession. A crooked limb, rendered so by injudicious treatment, is an unpleasant sight to a sensitive surgeon, reminding him constantly of his bad luck, his want of skill, or his inattention; not unfrequently it is a standing, living, speaking monument of his disgrace, planned by his own mind, and erected by his own hands. I would certainly not wish it to be understood by these remarks that it is always in the power of the surgeon to cure these accidents without deformity or impairment of function. To utter such a sentiment would be contrary to all experience and common sense. There are cases, and, indeed, they are not infrequent, where it is impossible to avoid such occurrences; cases where injury to bone, joint, and soft parts is so severe and complicated as to render any other result totally impracticable, however attentively and scientifically they may be treated. The physician cannot cure all diseases; such is their character that many must, of necessity, prove fatal, and of such as do not terminate in this manner, there are many which, notwithstanding the most skilful management, sadly cripple the patient for life. The only difference between the surgeon and the physician, under such circumstances, is that the former is often [illegible] if not severely censured, for the result of his treatment, perhaps long [illegible] nd anxiously continued, while the latter often receives nothing but commendation and praise, when he may be no more entitled to it than the other. Every one thinks he can judge correctly of a surgeon's skill, but very few persons attempt to fathom that of a medical practitioner.

A fracture may be defined to be a solution of continuity of the osseous tissue, or, in other words, a yielding and separation of the bony fibres, occasioned either by external violence or muscular contraction. The lesion presents itself in various forms, of which the principal are the simple compound, comminuted, impacted, and complicated. To these may be added the incomplete fracture, in which a bone, instead of being entirely broken across, is divided only in a portion of its diameter.

A fracture is said to be simple when it is unaccompanied by any wound of the soft parts directly over the end of its fragments, thus exposing them to view, or, at all events, permitting them to be felt. The case is a simple one, as far as the bone is concerned, even if there be a wound in the immediate vicinity of the fracture, provided it has no direct communication with it. A compound fracture is one where the opening in the skin and muscles extends down to the bone, the ends of which often protrude through the wound, girted, perhaps, by its edges. When a bone is broken into a number of pieces, the term comminuted is applied to it. The word impacted is employed to signify that the extremity of one fragment is forced into that of the other. Finally, a fracture is complicated when it is associated with dislocation, wound, hemorrhage, laceration, or other mischief. It will greatly facilitate the discussion of the subject if we discard all these terms, with the exception of the first and last. Hence, after some general observations, we shall treat first of simple fractures, and afterwards of fractures complicated with other lesions.

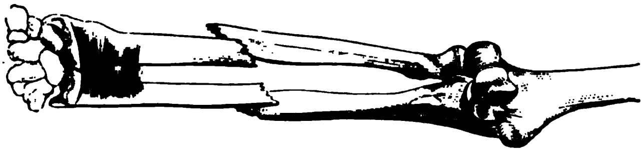
All the bones of the body are liable to be broken, though not by any means with equal *frequency*. Those which are most prone to suffer in this manner are the long bones of the extremities, particularly those of the leg and forearm. The clavicle is also frequently fractured. The scapula, the two jawbones, the sternum, ribs, innominatum, vertebræ, sacrum, and coccyx, together with the bones of the hand and foot, are rarely broken, owing either to their protected situation, to their mobility, or to the manner in which they are united to each other and to the surrounding parts. It may be stated also, as a general law, that the long bones are more liable to give way at or near their middle than at their extremities; a circumstance of some importance in a diagnostic and practical point of view.

The relative frequency of fractures of the bones of the superior and inferior extremities has not been satisfactorily determined. It doubtless varies in different institutions and in different localities, according to the nature of the occupations of those who are the subjects of them. The following tables, composed of the statistics of different hospitals, shows the preponderance to be very slightly in favor of the lower limbs:—

	No. of cases.	Upper extremity.	Lower extremity.
Pennsylvania Hospital	1473	572	901
Hôtel Dieu, Paris	1856	850	1006
Middlesex Hospital, London . . .	1280	764	516
Native Hospital, Calcutta	1346	665	681
	5955	2851	3104

Respecting their *direction*, fractures may be oblique, transverse, or longitudinal. Of these varieties, the first is by far the most common, though it is impossible, from the want of statistics, to estimate its relative frequency. My experience teaches me that transverse fractures are extremely rare. In the extensive osseous collection of Dr. Mütter, there is not a solitary specimen of the kind; and my own is equally barren. I am speaking now, of course, only of fractures of the long bones, and especially of fractures of their shafts; for in the short and flat bones such an occurrence is not without a certain degree of frequency. There is reason to believe that many of the so-called cases of transverse fractures of the shafts of the long bones are in reality oblique fractures, approaching more or less closely to the horizontal line, yet not strictly falling within it. There are few practitioners, I imagine, who will not coincide with me in this view, and who, like myself, have not had frequent occasion, upon further and more thorough exploration, to correct their diagnosis in cases of this description. If the question were one solely of a speculative nature, it would be of little consequence; but when we consider its practical bearing, it is impossible to lay too much stress upon it. As it will, however, be again adverted to when we come to speak of the treatment of fractures, nothing further need be said respecting it here. The annexed cut, fig. 321, conveys a good idea of an oblique fracture.

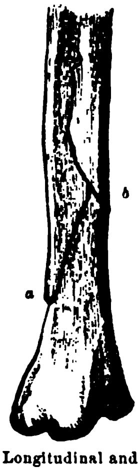
Fig. 321.



Oblique fracture of the bones of the forearm.

Longitudinal fractures are extremely rare, so much so, indeed, that great doubt was at one time entertained respecting the possibility of their occurrence. That they do, however, occasionally take place, is sufficiently established by the cases that have been published from time to time in our medical journals, and by the specimens that are to be seen in different museums and private collections. They are nearly always produced by gunshot violence, and have hitherto been met with chiefly in the humerus, femur, and tibia. In a very few cases the fracture has passed nearly through the entire shaft of a bone; but, in general, it is not more than a few inches in extent. Occasionally a fissure of this kind, after having passed a certain distance, runs off in an angular direction towards the surface of the bone, where it terminates, as in fig. 322. A longitudinal fracture is sometimes seen at the inferior extremity of the humerus, and also, but more rarely, at the lower end of the femur, separating one of the condyles of these bones, or even both of these protuberances, as happens when there is at the same time a horizontal or oblique fracture a short distance above the corresponding joint. A longitudinal fracture is occasionally met with in the patella.

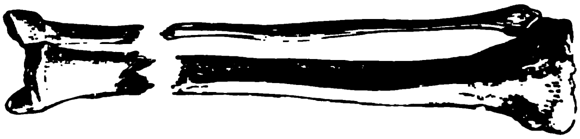
Fig. 322.



Longitudinal and oblique fracture.

The extremities of the fragments of a broken bone exhibit much diversity in regard to their form and size; in general, one is much larger than the other, as well as more sharp, rough, and irregular, as in fig. 323. In the majority of cases, they have a ragged, serrated, or denticulated appearance, the projecting pieces of one end corresponding with the depressions in that of the other. This arrangement, which is produced by the irregular division of the osseous fibres, bears no little analogy to that which occurs in the edges of a lacerated wound. The truth is, to carry out the analogy still further, an oblique fracture is nothing but a lacerated wound of the osseous tissue, which presents the same difficulty in regard to its perfect coaptation and speedy reunion as a similar lesion in the skin and muscles. The irregularities upon the extremities of the fragments are often sadly in our way, offering a great obstacle to the successful reduction and subsequent maintenance of the parts. Sometimes, indeed, the projecting pieces are so long and sharp as to pierce the integuments, or to require to be sawed off before the bone can be properly set. Such an occurrence is not uncommon in fractures of the tibia, and it is also witnessed, though less frequently, in the femur, the radius, and clavicle.

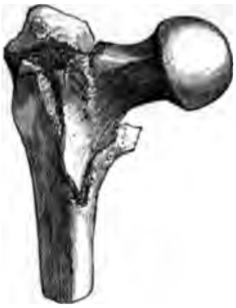
Fig. 323.



Appearances of the ends of the fragments.

Sometimes the fracture is *impacted*, that is, the end of one fragment is forcibly driven into the other, so as to be, as it were, interlocked. Such an occurrence, of which fig. 324 affords an excellent illustration, can only arise, as a general rule, in those bones which contain an extraordinary amount of areolar substance.

Fig. 324.



Impacted fracture of the neck of femur.

As a bone may give way at any part of its extent, at its middle, or at either end, it follows that the two fragments are rarely of the same length; instead of this, there is often a most marked disparity, as is exemplified in fractures of the extremities of the long bones, as the femur, in which, especially in fractures of its neck within the capsular ligament, the superior fragment is sometimes hardly an inch and a half in length, while the other is perhaps upwards of a foot and a quarter. Fracture of the olecranon affords a similar illustration. Such an occurrence is not without its influence in regard to the treatment and final issue of the lesion; for the nearer, as a general rule, the length of the fragments corresponds, the easier, all other things being equal, will it be to maintain their apposition, and secure prompt and perfect union.

A fracture may be single or multiple; that is, a bone may break at one or more places, sometimes as many as three, four, or even five; in other words, it may be literally crushed and comminuted. Such lesions are generally the result of inordinate violence, and are always liable to be followed by serious consequences; often, indeed, by loss of limb and life.

In fractures of the leg and forearm, affecting both bones, it is extremely rare to find the injury situated on the same level; on the contrary, there is generally a considerable distance between the two fractures, amounting, according to my observation of numerous cases, ordinarily to from one to two, three, and even four inches. The interval is usually considerably greater in the leg than in the forearm, probably because of the greater inequality in the size of its two bones. What the cause of this occurrence is it is not easy to determine; but it may be supposed that it is due mainly, if not entirely, to the manner in which these pieces are respectively articulated to the wrist and ankle-joints, in consequence of which the violence occasioning the lesion is transmitted more forcibly along one bone than along the other, thereby compelling the former to yield before the latter. Thus, as the tibia is more intimately connected with the foot than the fibula, it follows, if this explanation be correct, that it ought to break lower down than the fibula, and this, I believe, is what usually happens, although there are many exceptions.

Fractures occur at all *periods of life.* During delivery, the bones of the arm and leg are occasionally broken in rude attempts at extraction. In 1856, an infant, four weeks old, was brought to me on account of a fracture of the shaft of the right femur, caused two days previously by a child rolling over it in bed. The thigh was much swollen, and at least an inch and a half shorter than the sound one; all the extension and counter-extension that I could make with my hands failed to restore it to its normal length. Fractures occasionally occur in the fœtus in the womb. Chaussier met with a remarkable example of this description, in which each of the long bones had suffered more or less from these lesions, some of which were recent, others beginning to unite, while others were consolidated. The child survived its birth only twenty-four hours. Cases of a somewhat similar character have been reported by other observers. In childhood, the bones being remarkably flexible, on account of the large amount of animal substance which they contain, are particularly prone to give way at their epiphyses; in old age, on the contrary, they are very dense and brittle, from the presence of an inordinate quantity of earthy matter, and are therefore extremely liable to break from the slightest causes. Thus, a fracture of the neck of the femur within the capsular ligament is often produced by a mere twist of the thigh in bed, by catching the big toe in a fold of the carpet, or by stepping off the curbstone.

Causes.—The causes of fractures are generally divided into predisposing and exciting; the first having reference to the part and system, or to local and constitutional circumstances, the second to external violence and muscular action.

The conformation, situation, and office of certain bones are so many *predisposing causes* of fracture. Thus, as was before stated, the long bones, which are the great levers of locomotion, and which, in consequence, are constantly under the influence of large and numerous muscles, are much more subject to this accident than the short or flat bones, which are more passive in their character, as well as more closely articulated together, so that any force that may be communicated to them is more easily broken. The body of the scapula is seldom broken, because it is not only thickly covered by muscles, but, having no fixed point below, it is incapable of being injured by any shock transmitted by the hand, elbow, or shoulder. The acromion process, however, owing to its exposed situation, is not unfrequently fractured; while the coracoid process, protected by the deltoid, clavicle, and head of the humerus, rarely suffers from this cause. The radius, being articulated with the hand, is more liable to break than the ulna; the fibula, owing to its slender form and brittle texture, is oftener broken than the thick and heavy tibia; and every surgeon knows how very prone the collar-bone is to fracture, its exposed situation, the peculiarity of its conformation, and its connection with the sternum and scapula rendering it particularly obnoxious to this occurrence.

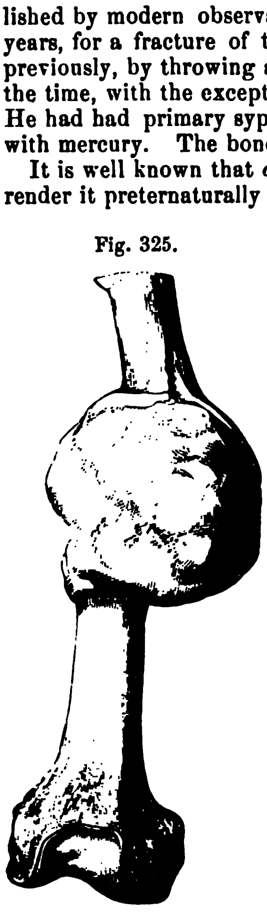
Of the influence of *age*, in promoting the occurrence of fracture, mention was made in a previous paragraph, and it need not, therefore, detain us here. It may be stated, however, that, as we advance in life, there is superadded to the preternatural brittleness of the osseous tissue, another cause of fracture, namely, abnormal rigidity of the muscles, thus rendering us more liable to falls, and, consequently, more prone to the accident in question.

Various *diseases* or states of the general system have usually been regarded as predisposing causes of fracture. Of these, the most common are syphilis, cancer, scurvy, and rickets.

That a *syphilitic* state of the system, involving the skeleton, may so affect some of the bones as to render them abnormally fragile is sufficiently established by modern observation. In 1847, I attended a man, aged thirty-one years, for a fracture of the body of the right humerus, caused, a short time previously, by throwing a small chip at a person. He was perfectly well at the time, with the exception of some nocturnal pain in the arm and forearm. He had had primary syphilis seven years previously, and had been treated with mercury. The bone united in five weeks.

It is well known that *cancer* may so alter the osseous tissue, fig. 325, as to render it preternaturally brittle, and thus predispose it to fracture. Such an occurrence, indeed, is probably not so uncommon as is generally supposed. I have myself, however, seen only one instance of it. The patient was a female, seventy-three years old, from whom I had removed, with the assistance of my former colleague, Professor Miller, nine months previously, the left mammary gland, on account of scirrhus, under which she had labored for nearly three years. The wound healed kindly, but, some time after, the disease reappeared at the cicatrice, and gradually carried her off, not, however, before she had become extremely emaciated and bedridden. During the last month of her life, she complained of almost constant pain in the right thigh, deep-seated, and particularly severe at night; and three days before she expired, in an attempt to turn in bed, the femur broke just above its middle. The limb was free from swelling and discoloration. No cancerous matter could be detected in the affected bone, which was quite soft, humid, and brittle, for some distance above and below the seat of fracture.

Fig. 325.



Encephaloid of the thigh, followed by fracture.

Of the influence which *scurvy* exerts upon the osseous tissue, in predisposing it to fracture, the modern practitioner has little opportunity of judging, as the disease at the present day seldom appears in that violent form which characterized it in former times. As described by the older writers, it was often attended with the most horrible ravages, in which the skeleton not unfrequently participated, the synovial membranes, cartilages, and ligaments being ulcerated, and the epiphyses separated from the bones. In 1855–6, the scurvy prevailed extensively in certain regions of the United States, especially in the Southwest, but I am not aware that it predisposed any of its subjects to the occurrence of fracture, or that it retarded the process of reunion in those who suffered from it at the time.

There are certain states of the skeleton, including *rickets*, in which the bones become so remarkably brittle as to break under the most trivial injury. Cases are recorded where, from these and other causes, nearly every one of the long bones was broken not only once, but a number of times. What is remarkable in these cases is that they usually recover quite as soon as ordinary fractures. I have in my collection a part of the skeleton of an old woman, who, in falling from a second-story window down upon the pavement below, received not less than fifty-three fractures, involving the vertebræ, the scapula, the bones of the pelvis, and most of the bones of the extremities.

Gout and *rheumatism* are sometimes enumerated as predisposing causes of fracture. The following case, which I saw with Dr. Metcalf, would seem to countenance the possibility of such an occurrence.

Henry Welker, a common laborer, aged thirty-two, had always enjoyed good health until two years and a half ago, when he was attacked with articular rheumatism, affecting the principal joints, first of the superior, and then of the inferior extremities, where it had continued for the last twelve months. The only cause which he could assign for his suffering was exposure to cold and fatigue in a pork-house, where he had worked for fourteen successive winters. In December, 1855, he broke his thigh-bone, at the junction of the lower with the middle third, while pulling off his boot with his hands, the foot being at the time bent at a right angle with the leg. No pain or swelling followed the accident. The most remarkable feature in the case, when Dr. Metcalf first saw it, was the imperfect aeration of the blood, as indicated by the livid state of the face; the bowels were torpid, the tongue was coated, and there was considerable emaciation, but no disease of the heart and lungs. No chalky deposit existed in the joints. At the end of a month and a half, the parts being united, the dressings were removed, and the man was permitted to walk about on crutches. A week after this, he struck the affected thigh slightly against the rail of the bed, fracturing the bone at its upper third. Union took place in about the same time as before, the quantity of callus in each case being uncommonly large.

The *exciting causes* of fracture are two, external violence and muscular contraction. The former, which is by far the more common, may act upon a bone either directly, or indirectly through some other bone. In the first case, the force is applied to the bone itself, as in fracture of the jaw from the kick of a horse, or in fracture of the leg from the passage of the wheel of a carriage. Most fractures are of this description, and hence they are generally complicated with more or less injury of the soft structures. In the other case, the force, instead of being applied immediately to the bone, is transmitted to it through another bone, or perhaps a chain of bones. It is in this way that the radius is so frequently broken just above the wrist by falls upon the hand, the force being concentrated upon its inferior extremity, in consequence of the manner in which it is articulated with the carpus, while the ulna, which is but slightly connected with it, generally escapes. Fracture of the clavicle affords an instance of a bone being broken by indirect mechanical violence operating at two opposite points. Thus, in falls upon the shoulder, the sternal end being impelled by the weight of the body, and the acromial end by the object which it strikes against, the bone, acted upon by the two forces, gives way at its weakest part, which is usually about its middle. When a bone is very brittle, the slightest external violence may be sufficient to break it. In old people the neck of the femur is frequently fractured by the merest twist of the limb in bed, or by stepping carelessly out of the bed upon the floor.

It is not often that a bone is broken by muscular action, and yet such an accident is not, perhaps, as uncommon as is generally imagined. I have myself met with several instances of it. In three, the subjects were remarkable for their health and muscular developments, and the fracture in each was produced while they were engaged in feats of strength, in which the elbows were planted firmly upon a counter, and the hands interlocked with each other. While the muscles of the arm and forearm were in a state of the utmost tension, the humerus snapped off suddenly, with a loud noise; in two cases at its middle, and in the other at its inferior extremity. In another case, the fracture, also seated in the humerus, was caused by throwing a small chip. In this instance, alluded to in a previous paragraph, the bone had suffered for a considerable time under nocturnal pains, and had evidently been rendered brittle by the effects of the syphilitic virus. The patient, aged thirty-one, was otherwise in good health, but the muscles of his arm were rather soft and flabby. The patella and olecranon are frequently fractured by the action of the extensor muscles of the thigh and arm. From the above cases, it is evident that a diseased state of the bone is not at all necessary to the production of this accident by muscular contraction, although such a change is perhaps generally present at the time of the fracture, and therefore deserves to be considered as a predisposing cause of it.

When the osseous tissue is preternaturally brittle, mere muscular spasm is capable of producing fracture, as in the interesting case related by Dr. Lente of a boy, twelve years of age, who broke both his thigh-bones during a severe epileptic convulsion.

2. SIMPLE FRACTURES.

The symptoms of fracture may be considered, first, in relation to the broken bone itself; secondly, in relation to the soft parts; and thirdly, in relation to the constitution.

So far as the affected bone is concerned, there are only three symptoms which are at all reliable as evidences of the existence of fracture. These are crepitation, deformity, and preternatural mobility.

Crepitation is the peculiar noise which is produced by rubbing the two ends of the broken bone against each other, and is always, when well marked, characteristic of the nature of the injury. In general, it can be both heard and felt. In order to produce it, it is necessary that the ends of the fragments should be at least partially in contact, and hence, to effect this object, the surgeon is often obliged, as a preliminary step, to extend and counter-extend the affected limb. For this reason it is always absent in impacted fractures, while in fractures of the leg and forearm, involving only one of the bones, it is usually very faint and indistinct from the difficulty of moving the broken pieces upon each other. Much swelling or great depth of muscle will also obscure the crepitation.

Deformity, although not invariably present, is, in general, one of the most prominent symptoms of fracture. It exhibits itself in different forms, as in shortening, or in angular displacement, and usually occurs at the time of the accident, the cause which produces the fracture being itself the cause of the distortion. Occasionally, however, it does not come on until several hours, or perhaps even days after; as, for example, in a partially impacted fracture of the neck of the thigh-bone, in which the patient may be able to walk some distance, and yet the limb retain its normal shape. The degree and character of the deformity are greatly influenced by the nature and situation of the fracture. Thus, the more oblique a fracture is, the greater, as a general rule, will be the displacement of the ends of the fragments, and, consequently, also, the distortion of the limb. Sometimes, as in fracture of the patella, the olecranon and calcaneum, the deformity manifests itself by a vacuity or hollow at the natural situation of the bone, and by an unusual protuberance upon the lower part of the thigh, arm, and leg, caused by the separation of the upper fragment by the action of the extensor muscles. Finally, the deformity may be much increased by the extravasation of blood consequent upon the injury, or by the effusion of serum and lymph consequent upon the resulting inflammation.

Preternatural *mobility* is, next to crepitation, the most important and reliable symptom of fracture. There are few instances in which it is wholly absent, while in the great majority it exists in a well-marked, if not in a high, degree. It usually appears immediately after the occurrence of the accident, and continues to a greater or less extent until the completion of the consolidation of the fracture. In the impacted fracture it may be entirely wanting, or remain absent until the ends of the fragments are unlocked. In fracture of the leg and forearm, involving only one bone, the degree of mobility is sometimes very slight, the sound bone impeding or altogether preventing the motion of the affected one.

In every fracture produced by external violence, whether applied directly or indirectly to the part, there must, of necessity, be a certain degree of *contusion* of the soft structures at the seat of the injury. It may be limited to the skin and subjacent cellular tissue, or it may extend deeper, and involve the muscles, aponeuroses, vessels, nerves, periosteum, and even the bone itself. In consequence of this occurrence, there is not unfrequently a considerable effusion of blood beneath the skin, and in the connective tissue of the muscles, causing distension and sometimes discoloration. For the same reason, there is generally a good deal of pain, often of a sharp, spasmodic character, which is aggravated by the slightest motion of the parts, and by every attempt at exploration. It has its seat rather in the soft structures than in the affected bone, although the latter generally participates in it, and by the sharpness of its extremities frequently increases its severity. A short time after the accident, swelling usually sets in, and often proceeds to a considerable height, its degree being greatly influenced by the amount of injury sustained by the soft parts, by the motion to which the fractured bone is subjected, and by the state of the system at the time of the accident. As a general rule, it may be affirmed that the pain and swelling are less in fractures produced by muscular contraction than in such as are caused by mechanical violence, whether directly or indirectly applied.

Inability of motion in the affected bone, and in the portion of the limb articulated with it, is generally a prominent symptom. Cases, however, occur in which it is either very slight or where it is entirely absent. In an impacted fracture of the thigh, for instance, a patient has sometimes been known to be able to walk for a considerable distance without the slightest assistance even from a cane, and in fracture of the clavicle, I have repeatedly seen him carry his hand to his head, and even circumduct the arm.

Another symptom, consequent upon fracture, is *spasm* of the muscles at the seat of the injury; it is most common in nervous, irritable persons, and generally comes on within a short time after the accident. When severe, as it frequently is, it constitutes a source of real suffering. It is aggravated by motion and inflammation, and may continue, with more or less interruption, from several hours to several days.

Finally, the patient often experiences a sense of *numbness* in the affected part, reaching frequently to the distal extremity of the limb. This may be caused either by the injury sustained by a nervous trunk at the time of the accident, or by the compression of the soft parts by extravasated blood, or the ends of the broken bone. Sometimes it does not arise until inflammation has supervened, and then it is generally owing to the presence of an unusual quantity of serum and lymph.

The amount of *constitutional disturbance* in fracture varies, in different cases, from the slightest exaltation of the normal action to the most intense excitement, depending mainly upon the nature of the fracture, the degree of violence sustained by the soft parts, and the state of the system at the time of the accident. In very many cases, there is an entire absence of traumatic fever, while in others it is present in a very high degree, the pulse being strong and frequent, the countenance flushed, the skin hot and dry, the thirst intense, and the appetite and sleep much impaired, if not totally suspended. In the more severe forms of fracture, the patient often experiences a severe shock, from which he may not fully recover for many days, or which may even terminate in death. Whenever there is much constitutional disturbance, the affected limb will be apt to be in a high state of inflammation, the parts being hot, swollen, and painful, and, at times, even covered with small vesicles, such as a heedless observer might easily mistake for the phlyctenulæ which so often announce the occurrence of gangrene.

Displacement of the Ends of the Fragments.—The displacement of the fragments shows itself, as already stated, in two principal directions, the longitudinal and horizontal. Of these, the former is by far the more common, as it is present, to a greater or less extent, in nearly all cases of oblique fracture, in whatever portion of a bone occurring. It is produced by the overlapping of the extremities of the broken bone, the lower being drawn above the upper, or the one riding over the other, as it is sometimes expressed. The extent of this form of displacement varies from the slightest possible change in the length of the affected bone to two, three, and even four inches, which may be regarded as its maximum. It is generally most conspicuous in fracture of the femur and humerus, while in fracture of the forearm and leg, affecting only one bone, it is either very slight or totally wanting. Finally, the displacement may be lateral, anterior, or posterior, according to the nature of the exciting cause.

In the horizontal displacement, the lower fragment may form an angle, more or less acute, with the superior, thereby giving the bone an arched appearance; or, the two pieces remaining in contact with each other, the inferior one may perform a rotatory movement, while the other continues perfectly stationary. In some cases, as in fracture of the lower end of the radius, there is often considerable lateral displacement, and similar phenomena are apt to occur in fracture of the tibia and fibula at or near the ankle-joint.

The causes of displacement are, muscular action, mechanical violence, and the weight of the limb connected with the broken bone. Of these the first is the most common, and it need hardly be added that a knowledge of the fact is of the greatest practical importance in regard to the proper management of the injury. In some instances the displacement is entirely produced by the vulnerating body. Thus in fracture of the nose, the blow which inflicts the injury also displaces the fragments. The wheel of a carriage passing over the leg may not only break its two bones, but likewise cause great deformity by forcing asunder their extremities. Finally, the displacement may be occasioned by the weight of the limb connected with the injured bone, as in fracture of the clavicle, in which the outer fragment is drawn downwards and inwards by the weight of the shoulder and arm.

Diagnosis.—The most valuable symptoms of fracture, diagnostically considered, are, crepitation, deformity, and preternatural mobility. The coexistence of these symptoms is unmistakably denotive of the nature of the accident, but, unfortunately, they are not always associated; one or even two may be absent, and hence a case that ought to be treated in the most prompt and decisive manner, may, for the want of a correct appreciation of its character, be either entirely neglected, or, at all events, grossly mismanaged. Besides, the symptoms here enumerated may be simulated by other accidents, especially dislocation, and certain affections of the joints.

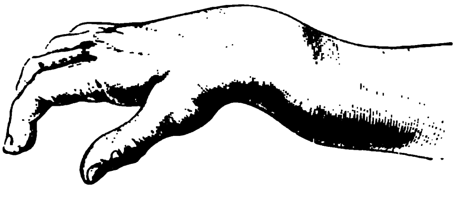
The crepitation of fracture is sometimes imitated by the grating produced by an effusion of plastic matter into a joint, the sheath of a tendon, or a synovial burse; and the difficulty may be still further increased, if, under such circumstances, the suspected fracture is situated near a large articulation. In general, however, it will be sufficiently easy to distinguish between them by a consideration of their respective characters. In fracture, the crepitation can be both felt and heard; it is dry, coarse, or rough, resembling the sensation and noise produced by rubbing two unequal surfaces against each other. The crepitation from plastic matter, on the contrary, is of a finer quality, or more faintly marked, and may be likened to the feel and noise caused by gently rubbing over each other two pieces of sole leather; in a word, it lacks the roughness and distinctness of the other. Moreover, it must be remembered that it is never present until after the occurrence of inflammation, whereas the other always exists from the very beginning of the accident. Crepitation, it is true, might be produced in consequence of previous disease, and the possibility of such an occurrence should not be lost sight of in our examinations. Finally, when the case is obscure, the crepitation may sometimes be detected by the aid of the stethoscope, especially when the bone is thickly covered by muscles, as in fracture of the neck of the femur within the capsular ligament, or in fracture of the ribs in corpulent subjects. This mode of examination was originally suggested by Lisfranc, but, as the expectations held out by him have not been realized, few practitioners of the present day resort to it.

The deformity in fracture manifests itself either in shortening, in lateral displacement, or, as not unfrequently happens, in the two united. Elongation is never present, in which respect fracture differs from certain forms of dislocation, in which lengthening is a prominent symptom. The degree of shortening varies from a few lines to several inches, and is, therefore, an occurrence of much value in a diagnostic point of view. It may exist from the commencement of the accident, or it may not show itself until some time after its occurrence, being materially influenced by the action of the muscles, and the nature of the treatment. Whatever the degree of the deformity may be from these causes, it may always be effectually removed by extension and counter-extension, either alone or aided by pressure; but as soon as these forces cease to operate, it is usually immediately reproduced, which is not the case in dislocation. Here, the reduction having been effected, the parts generally retain their relations until some new cause produces a new displacement.

Too much stress cannot be placed upon preternatural mobility as a sign of fracture. Next to crepitation, it is unquestionably the most important diagnostic symptom. There may be unnatural latitude of motion in a dislocation, but this can happen only when the accident is attended with extensive laceration of the ligaments of the joint; in ordinary cases there is either an absence of motion, the displaced bone being firmly fixed in its new position, or the motion is so slight as to bear only a faint resemblance to that observable in fracture.

The general expression of the affected parts, fig. 326, often affords valuable diagnostic signs. The deformity, for example, of the hand and wrist, in fracture of the lower extremity of the radius; the eversion of the toes in intra-capsular fracture of the femur, and the shortened and retracted appearance of the arm in fracture of the humerus, are generally unmistakable evidences of the nature of the accident. The manner in which the patient inclines his head and supports the elbow and forearm in fracture of the clavicle, is too significant to be overlooked by any one that has ever witnessed it. The peculiar aspect and attitude of a broken thigh,

Fig. 326.



Fracture of the lower end of the radius.

conjoined with the utter helplessness of its muscles, or the absence of all voluntary power, are signs which seldom admit of misinterpretation.

The pain, swelling, and loss of function, present in suspected fracture, are of no practical value, as similar phenomena are produced by other injuries, as contusions, wounds, sprains, and dislocations. Their occurrence being wholly accidental, must, therefore, not influence the surgeon in his attempt to form a correct estimate of the real nature of the case, or the relative value of the symptoms of this and other analogous affections.

Mode and Time of Examination.—Although the symptoms which have now been described will generally be sufficient, along with a careful consideration of the history of the case, to enable the surgeon to determine the diagnosis of this lesion, especially if he will take the trouble of comparing them with the symptoms of other accidents, it will, nevertheless, be proper, in concluding this branch of the subject, to say a few words respecting the manner of conducting the examination of the affected parts, as the ultimate issue of the case will greatly hinge upon this circumstance.

My experience satisfies me that few practitioners know how to examine a broken limb. They take hold of it as if they were afraid of giving pain, or causing suffering, and the consequence is that the result is often most disastrous. I am far from wishing to be understood as being an advocate of rough surgery; on the contrary, no one abhors it more than I do, yet there are times and circumstances when the best interests of the patient demand that he should be most thoroughly examined, no matter what amount of pain he may be compelled to undergo. But there is no need any longer of such infliction now that we can prevent suffering by anæsthesia. The patient being rendered insensible, perquisition is performed at the surgeon's leisure, slowly and deliberately, and with an eye to the ultimate result, not forgetting self. The sooner such manipulation is instituted the better, for there will be less likely to be inflammatory swelling and other obstacles calculated to embarrass our progress and obscure the diagnosis. Fractures of the shafts of the bones will rarely afford any difficulty, inasmuch as their symptoms are generally so well marked that the most casual inspection will be sufficient for their detection. But it is different when the lesion involves their extremities. Here the most laborious and pains-taking examination sometimes hardly enables the practitioner to form an accurate judgment respecting the real nature of the injury. Under such circumstances, therefore, he must not content himself with one or two trifling explorations, but he must handle the parts again and again, until he has thoroughly established the diagnosis. If, after repeated trials, he is still in doubt, it is his duty to state this doubt to his patient, and to seek the advice of a professional brother in order to aid him in solving the question. By adopting this course, he will be more likely to do justice to his patient, and at the same time escape personal blame.

For the reason already assigned, the parts should always be examined as early as possible after the infliction of the injury, but I would make no exception where some time has elapsed, and a good deal of swelling has supervened; for it is impossible that a broken bone, or the parts by which it is covered, should do well as long as its extremities are displaced, and thus permitted to fret, irritate, and perhaps prick the muscles and other structures in contact with it. Hence, the sooner the fracture is adjusted or the parts are placed in their natural relations, the more likely will they be to do well, and escape the ill effects of inflammation. There are instances, however, where, as may be supposed, immediate interference might prove highly prejudicial, using the term immediate here with reference to the surgeon's first visit. The patient may have been neglected, or his attendant may have mistaken the nature of the case, and in this manner several days may have passed uselessly away. The limb is now found in a very swollen and painful condition, intolerant of the slightest manipulation, nay, perhaps in an erysipelatous condition. To make an elaborate examination under such circumstances would be highly improper; for it could not fail to aggravate the morbid action, and perhaps urge it on to gangrene. The hand is withheld; the limb is placed in an easy position, and antiphlogistics, both local and constitutional, are freely plied; when action has sufficiently abated, but not until then, the proper examination is effected, and the diagnosis, if possible, established.

The mode of conducting the examination varies. In the upper extremity the surgeon will usually be able to get on without any assistance, but in fracture of the thigh and leg it will often be necessary to make extension and counter-extension while the parts are subjected to methodical manipulation. When there is marked displacement, the merest touch of the hand will generally suffice to detect the nature of the lesion; but, under opposite circumstances, the nicest digital exploration may be required before a satisfactory result can be obtained. In general, it will be necessary to make pressure and counter-pressure at the seat of the injury, and to rotate the portion of the limb below the fracture upon its axis. In this manner, especially if proper extension have been made, the ends of the fragments being brought in contact may be made to yield the friction-sound, previously described, and at the same time display the full extent of their mobility. Another procedure is to grasp the two extremities of the suspected bone, and then, while the superior one is firmly held with the thumb and fingers, to roll the inferior upon its axis. If, while this is being done, both parts move together, the probability is that there is no fracture, but if the lower should move, and the upper remain stationary, there can be no doubt of the fact.

Mode of Repair.—The mode of repair in fracture is precisely similar to that of the soft parts, the only difference being the superaddition of the carbonate and phosphate of lime, or the earthy constituents of bone. In order, however, to be thoroughly understood, it is necessary to study it with reference to the situation and disposition of the ends of the fragments of the broken bone, as the rapidity and perfection of the cure are greatly influenced by the manner in which they are arranged and held together during the treatment. The more perfect this is, the more complete, generally, all other things being equal, will be the reunion. For practical purposes, the whole subject of repair may be considered as consisting of four stages.

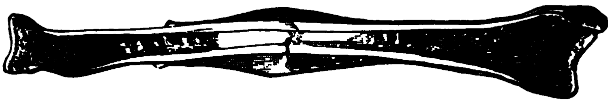
The first stage, which, on an average, extends from the first to the eighth day, is one altogether of preparation, in which nature clears away the rubbish, and places the ends of the fragments in a suitable condition for the process of repair, properly so called. The blood which was extravasated at the moment of the accident, at and around the seat of the fracture, is in great degree, if not entirely, absorbed; the inflammatory products, especially the intermuscular, are also disposed of; the swelling subsides, the pain disappears, and there is no longer any tendency to spasmodic action, the muscles having become calm and quiet under their new relations. Any traumatic fever that may have been present will also be found to have vanished. Thus the part and system have happily passed through the preliminary stage of the reparative process.

If the parts be examined at the commencement of the second stage, it will be seen that the ends of the broken bone, as well as the periosteum, and the other soft parts in their immediate vicinity, are abnormally red and injected, and covered by plastic matter, resembling very much in its color and consistence pale currant jelly, or a thick solution of isinglass. It is usually most abundant upon the surface of the bone, and is often sufficient to lift up the periosteum; a considerable quantity is also generally seen between the periosteum and the muscles, and even among the muscles themselves, all these structures being more or less actively engaged in the process of repair. A similar substance, but usually less abundant, is poured out within the medullary canal, the lining membrane of which is also in a state of inflammation, as is evinced by its discolored and injected condition. In the latter part of this stage, which lasts from the eighth to the twentieth day, the newly-effused matter, which differs in none of its properties from that which serves to unite a recent wound, becomes gradually more and more solid, until at length it assumes the consistence of a concrete substance.

The third stage is characterized by still further changes in the consistence of the effused matter, and by its gradual conversion, first into fibro-cartilage, then into cartilage, and finally into bone; or, more correctly speaking, cells are developed in the new substance, into which the osseous granules are deposited, the whole process bearing the closest possible resemblance to that which takes place in the formation of the original bone. The period at which the bony matter begins to be developed in the adult varies from the eighteenth to the twenty-fifth day, its appearance and progress being influenced by numerous local and constitutional causes, to be described under another head.

The ossific process proceeding in the way now described, two layers of bony matter are formed, one lying upon the outer surface of the fragments, the other within the medullary canal, each extending some distance beyond the seat of fracture, as is seen in fig. 327. To these two strata is confided the office of temporarily supporting the fragments, or of holding them together until their ends are permanently united by osseous substance; a circumstance which does not take place, as a general rule, until several months later. To this new matter the older pathologists applied the term *callus*, in consideration of its hardness, which, when the process of repair is completed, is fully equal to that of the original bone, which it also closely resembles in its structure. From its office, the outer and inner callus, or that which invests the broken bone and lies in its medullary canal, is now universally known as the temporary or provisional callus, while that which is placed between the two ends of the bone, and thus serves to cement them together, is designated as the definitive or permanent callus. The temporary callus is, figuratively speaking, nature's splint, or the means which she employs to support the fractured bone until the continuity of the fragments is re-established by the deposit and organization of osseous matter between their extremities.

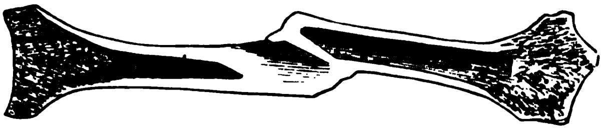
Fig. 327.



Fractured tibia, bisected, to show the formation of new bone beneath the periosteum, and within the medullary canal.

As the first stage in the reparative process is one of preparation, so the last is one of completion; reunion having been effected, nature now busies herself in removing whatever is redundant or superfluous, thereby fitting both bone and muscle for the resumption of their respective functions. The provisional callus, having ceased to perform its office as a splint, is gradually brought under the influence of the absorbents, its more superficial portions being taken away first, and afterwards the more deep, until the broken bone regains not only its original form and volume but also its pristine smoothness, all evidence of fracture disappearing, excepting, perhaps, a little seam or ridge corresponding with the line of junction of the two fragments. While these changes are going forward upon the exterior of the bone, nature is busy at work in its interior, disposing of the provisional callus in that situation, and thus restoring the medullary cavity to its normal condition. This can occur, however, only when there has been perfect apposition of the ends of the fragments; for when the reverse is the case, the new bone remains permanently in the canal, as is shown in fig. 328, from a specimen in my collection.

Fig. 328.



United fracture, showing the condition of the medullary canal.

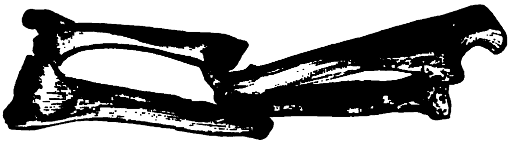
Any cartilaginous or osseous matter that may have been formed between the periosteum and muscles, or among the muscles themselves, is likewise removed as a substance foreign to the part, and therefore useless, if not positively prejudicial.

It will thus be seen that the fate of the provisional callus is precisely similar to that of the plasma which is effused between the edges of a wound, both gradually disappearing as soon as their service can be dispensed with, or as soon as the parts have acquired sufficient firmness to enable them to maintain their connection. The period required for effecting these changes in a broken bone varies from a few weeks to several months, according to the circumstances of the case.

Such is a brief but accurate account of the several changes which attend the repair of bone in the more simple forms of fracture, when the ends of the fragments are thoroughly maintained in their natural relations. Under such circumstances there is but little need of provisional callus; the ends of the fragments soon inflame, and unite almost by the first intention. But it is seldom that a patient is so fortunate; on the contrary, the fracture being generally oblique, is subject to more or less displacement, thus compelling nature to provide a temporary splint by the formation of provisional callus. I do not believe, however, as has recently been so much insisted upon, that there ever is an entire absence of this kind of callus, however intimately the ends of the bones may be in apposition with each other. To prove the truth of this remark, it is only necessary to examine the numerous specimens of fracture of the skull and other portions of the skeleton in our museums; they will conclusively demonstrate that even the most simple fracture, unaccompanied by the slightest displacement, is never repaired without the development of a certain quantity of osseous matter upon its surface. At the same time it must be admitted that the provisional callus, in such cases, is very small, and that it bears no proportion to the enormous amount of substance that is so often formed when the ends of the bone are separated from each other. Under the latter circumstances, nature labors under great disadvantage, and is, therefore, obliged to make extraordinary efforts to effect reunion, which she can do only by the development of a large provisional callus. From these facts, then, we may deduce the general law that the quantity of new bone is always, other things being equal, in proportion to the contact of the ends of the fragments, being small when this is very accurate, and more or less large when it is imperfect.

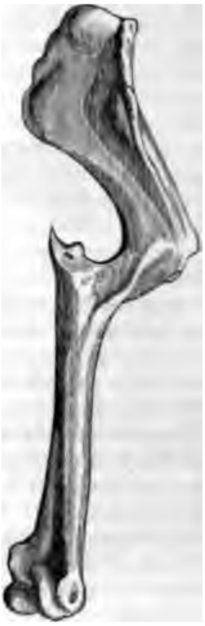
When the ends of the bone are not accurately approximated, the first thing that nature does is to round off their edges, and to close the medullary cavity by a shell of new bone, as in fig. 329; the next, is the formation of a large provisional callus for the more secure consolidation of the fracture. The whole process is one of time and labor, not of speed and ease, as in the former case. When the ends are completely separated but opposite, or nearly opposite to each other, they are generally united by a bridge of new bone, extending from one to the other, as in fig. 330, and ultimately affording sufficient strength for the support of the weight of the body upon the affected limb. Or, instead of this, especially in elderly subjects, the junction is effected by fibrous, fibro-ligamentous, or cartilaginous matter. Finally, osseous union is not impossible when the extremities of the fragments overlap each other to an extent even of several inches, provided they are in contact; for in this case inflammation is established in the contiguous surfaces, followed, after a long time, by a large permanent callus. We see many curious specimens illustrative of this fact, though, in general, the union is ligamentous.

Fig. 329.



Appearances of the ends of the fragments in old, ununited fracture.

Fig. 330.



Fracture of the arm-bone of a chicken. From a specimen in the author's collection.

There are certain pieces of the skeleton in which in fracture no provisional callus ever forms. Such are the olecranon, acromion, patella, and neck of the femur. Instead of uniting by osseous matter, as the other bones do, the cure is generally effected through the medium of fibrous, ligamentous, or cartilaginous substance, and the consequence is that the part commonly remains weak ever afterwards. Various causes conspire to produce this result, as the difficulty of maintaining the contact of the broken surfaces, and the inordinate secretion of synovial fluid, which, mingling with the effused plasma, thus impairs its vitality, and renders it unfit to become the nidus of bony deposit; but the most efficient one of all is the want of nourishment of the smaller fragment produced by the laceration of the nutrient vessels. Thus, in fracture of the neck of the femur within the capsular ligament, the upper piece, consisting of the head of the bone and of a portion of its neck, the only connection between it and the rest of the body, is by the round ligament, the arteries of which are altogether unequal to its proper support.

Treatment.—The leading indications in the treatment of fracture are to procure reunion and to prevent deformity. Before we proceed to speak of the manner of fulfilling these indications, it is proper that we should lay down certain rules for the transportation of the patient and the manner of preparing his bed.

Fractures are often received by persons at a considerable distance from their homes, either on the road, in the field, or at some secluded building. This renders it necessary to carry them to their own houses or to some hospital, in order to undergo the proper treatment. In fractures of the superior extremity, clavicle, scapula, or ribs, the requisite dressings may be applied at once; or, if this be not convenient, the patient may either walk or ride, the suffering limb being supported in a sling, or, as in the case of a broken rib, the body may be swathed with a long napkin. It is only, as a general rule, in fractures of the inferior extremity, spine, or pelvis, that the patient will require to be carried, and the best way of effecting this, if the distance be not too great, is to place him upon a narrow door, a long shutter, or two pieces of board, supported by two cross-pieces, the ends of which are intrusted to four assistants, a pillow and comfort having been previously put under the patient's head and body. Or, instead of this, the transportation may be conducted by means of an easy furniture-car, provided with a good mattress, and drawn slowly along in order to avoid jolting. Whatever mode be adopted, the limb should be temporarily splinted, and placed in as comfortable a position as possible, an intelligent person sitting by his side, and rendering such aid as may be required on the way. In carrying him to his chamber, four assistants will generally be necessary, two to support the body, which they do by crossing their arms behind the trunk, and interlocking their hands, and two for the lower extremities, the surgeon himself taking charge of the broken one.

A comfortable *bed* is to a man with a broken thigh or leg an indispensable article, and the practitioner who fails to give the proper instructions respecting it, is guilty of a gross dereliction of duty. Indeed, for his own sake hardly less than for that of his patient, he should give prompt attention to this subject, inasmuch as it is impossible to effect a good cure without it. When we reflect upon the fact that in fractures of the lower limbs, the patient is often compelled to remain in the recumbent posture for weeks together, and how difficult it is, in most cases, to maintain the requisite extension and counter-extension, the force of this injunction cannot fail to be perceived in its true light. The essentials of a good fracture-bed are, first, firm and stout slats, instead of a cord or sacking bottom; secondly, a well constructed mattress of hair, moss, or cotton; and thirdly, a hole in the mattress, opposite the buttock, for the evacuation of the bowels, the opening being closed by a door of similar manufacture, and furnished with hinges and other appliances. If long confinement be necessary in one posture, or if the patient have been worn out by previous disease, an air-mattress may be required, in order to prevent bed-sores. If a sheet be used, its edges should be carefully secured to the sides of the mattress, otherwise it will soon become rumpled, and thus act as a source of annoyance.

It has been a question which has been much mooted in modern times, whether a fracture should, as a general principle, be set as soon as possible after its occurrence, or whether time should be allowed for the subsidence of the resulting inflammation. It appears singular that upon a subject so clear as this there should be any difference of opinion. It certainly requires no great knowledge of the nature of accidents to discover why such cases should receive the earliest possible attention; as long as the ends of the fragments are permitted to remain apart, their tendency inevitably must be to excite spasm and inflammation, thereby increasing the suffering of the patient and retarding his cure. Of this fact there can be no doubt, and hence my plan has always been to treat every case of the kind that has come under my observation as early as possible with the bandage and splint; applied, of course, not firmly, but gently and cautiously, simply with a view of giving support to the parts, and thus preventing further mischief from the sharp and projecting ends of the broken bone. I can hardly imagine an instance to which such treatment would not be adapted. I certainly have never seen one. We might as well expect that a man's limb would do well if it had a thorn imbedded in its muscles, as that it would be comfortable with two
bone sticking in them. It is an absurdity to think it could b

Apparatus.—Before an attempt be made to set the fracture to provide the requisite apparatus for effecting its maintenance. The means which are employed for this purpose are splints, cushions, bandages, and adhesive strips.

Splints are made of various materials, as wood, trunk-board, leather, felt, gutta percha, tin, and iron, according to the nature of the fracture or the fancy, whim, or caprice of the practitioner. In fracture of the thigh and leg, especially in that form which requires permanent extension and counter-extension, the best article is *wood*, adapted to the size and shape of the limb, at the same time that it combines lightness with strength. In fracture of the superior extremity, particularly of the humerus and of both bones of the forearm, splints made of *trunk-board* generally answer best, as by a little manipulation, after immersion in hot water, they may easily be moulded to the form of the limb. A piece of pasteboard affords a capital support to a broken jaw or finger. Unoiled *leather* and *felt*, the latter being rendered stiff by gum shellac, make excellent splints, which I have often used with much satisfaction in fractures both of the upper and lower extremities. Previously to applying them, they must be softened in hot water, the sharp angles and edges having been pared off with a knife. The *tin case* I have employed a great deal, especially in fracture of the humerus at the elbow, and of the tibia at the ankle, ever since I entered the profession. *Iron* splints, in the form of the double inclined plane, are much in vogue in England; but in this country, little use is made of them. Many years ago, I was induced to make trial in a few cases of fracture of the condyles of the humerus and of both bones of the forearm, of a splint composed of light *wire*, adapted to the size and shape of the limb; but not answering my expectations, on account of its not being as manageable as I had been induced to expect, I soon abandoned it. For fracture of the bones of the hand and fingers, *carved* splints are sometimes employed. During the last twenty-five years an immense number of patented apparatus have been presented to the notice of the profession; but I am not aware that any of them have come into general use, or that they possess any particular advantage over the more common contrivances.

Splints made of *gutta percha* have recently come into vogue, not, perhaps, without reason on account of their neatness and easy adaptation. Cut into a proper shape and size, they may, after having been dipped in hot water, be readily moulded to the form of the part, which, upon cooling, they always retain. Previously to applying them, they are lined with wadding, or old linen, to prevent irritation of the skin, which this substance might otherwise induce.

Mons. Maisonneuve employs splints made by saturating a piece of cloth, linen, or muslin, with a thick solution of plaster of Paris in water, and then doubling the cloth upon itself as many times as may be requisite to obtain the proper strength, when it is immediately secured to the limb with a roller. The advantages of this apparatus are that it dries in a few minutes, and that it thus forms almost instantaneously a firm, stiff shell for the broken limb, perfectly adapted to its inequalities, exceedingly light, indisposed to absorb discharges, and admitting of easy application and removal.

Fracture-cushions are generally made in the form of small bags, stuffed with bran, fine chaff, cotton, wool, hair, moss, or any other soft material. They are designed to fill up the inequalities between the splints and the limb, and must necessarily vary in shape, length, breadth, and thickness, according to the exigencies of each particular case. Instead of cushions, simple pads or compresses are often used, especially in fractures of the superior extremities. For enveloping short splints, calico or muslin is employed; or, what I always prefer, sheet wadding. The same article answers admirably for filling up the inequalities between the short splints and the affected limb. Bags filled with sand are sometimes very convenient and useful, especially in fractures of the leg. Stretched along each side of the limb, they keep up steady, equable pressure, well calculated to prevent displacement of the fragments.

The fracture *bandage* should consist of coarse linen, calico, or muslin, and should possess sufficient strength to answer the purpose for which it is intended. Nothing is worse, or more likely to cause annoyance, than a thin, flimsy bandage. If the material is new it should be washed before it is used, to rid it of its starch, and the selvage should be torn off to prevent it from exciting irritation, or producing welts in the skin. The bandage most commonly used is the ordinary single-headed roller, of a length and breadth suitable to the affected limb or part of the body to which it is to be applied. In fractures of the leg and thigh, especially such as are of a complicated character, the bandage of Scultetus may often be advantageously employed, as it can be easily undone and reapplied without the slightest disturbance of the limb. It consists of numerous strips of the ordinary roller, of equal or unequal length, according to the size and shape of the part which they are intended to surround. In applying them, they are arranged in such a manner that one overlaps another nearly one-half.

The practitioner cannot observe too much caution in the use of the bandage in the treatment of fractures. It is an agent for good or for evil; for good, if applied properly; for evil, if applied improperly. Its object is twofold: first, to afford uniform compression of the limb, thereby preventing swelling and spasm; and secondly, to retain the necessary apparatus. Its application is governed by the general principles laid down in a former part of the work, the rule being always to begin at the remote part of the limb, and to proceed thence upwards some distance beyond the seat of the fracture, care being taken to put it on with sufficient tightness to fulfil the object for which it is designed, without incurring the risk of interrupting the circulation, or of doing other mischief. If it be too slack to support the parts in a proper and uniform manner, it will be useless; if, on the other hand, it be too tense, it will give rise to severe inflammation, swelling, and even gangrene. For the want of this precaution, many limbs have been lost, and a still greater number rendered permanently useless.

American surgeons are now much in the habit of employing *adhesive strips* in the treatment of fractures, either as retentive means, or for the purpose of effecting and maintaining extension and counter-extension. In their latter capacity, I was the first, I believe, to call attention to the subject, in my Treatise on the Diseases of the Bones and Joints, published in 1830. I had witnessed their excellent effect in the practice of my former preceptor, Dr. Joseph K. Swift, of Easton, in a case of oblique complicated fracture of the leg, attended with so much injury of the soft parts as to interfere effectually with the employment of the gaiter and other counter-extending bands. The man had suffered a great deal of pain, until his patience was almost exhausted, when trial was made with adhesive strips, carried along the sides of the limb towards the knee, their free extremities being tied below the foot, to the transverse block connecting the two splints. Great comfort was the consequence, and the case progressed favorably from that time forward. Soon after I had occasion to use adhesive strips in a case of my own, with results equally gratifying. Since then I have employed this substance with great advantage in the treatment of fracture of the clavicle, olecranon, and patella, as well as in the treatment of fracture of the thigh and leg. Valuable papers have been published on this mode of management, within the last few years, by Dr. E. Wallace, Dr. Gilbert, and Dr. Neill, of this city, and Dr. Crosby, of New Hampshire. In a short article in the Philadelphia Medical Examiner for 1852, I also called attention to the subject, giving very briefly the results of my experience up to that period. Dr. John Swinburne, in a paper recently published on fractures of the long bones, states that he has been in the habit, for several years past, of treating these injuries almost exclusively with the aid of adhesive plaster, generally dispensing with the roller and often even with splints. The importance of this agent, for the purposes referred to, will be fully pointed out under the head of special fractures.

Coaptation and Dressing.—Everything having thus been provided, and the requisite number of assistants obtained, the surgeon proceeds to restore the broken pieces to their original situation, or, to use a common expression, to set the fracture. This may be done either by simple manipulation, or pressure and counter-pressure, or by this means aided by extension and counter-extension. The former will usually suffice in fracture of the upper extremity, the jaw, and nose, while the latter will generally be required in fracture of the thigh and leg; in either case, the affected limb should be held as quietly as possible, not only during the adjustment of the fragments, but also during the application of the dressings. It need hardly be observed that these manipulations should be conducted in the most gentle manner, with an eye both to present comfort and future consequences. There is no department of surgery, where the humane practitioner may exhibit his skill and sympathy to greater advantage than in this, or where his conduct will be more closely watched and commented upon, than on such an occasion.

Extension and counter-extension are always necessary in oblique fractures of the thigh and leg, attended with displacement. By the term extension is understood the force which is required to draw the upper end of the lower fragment to a level with the lower end of the upper fragment, in order to place them in their natural relations; by counter-extension, on the contrary, is implied the resistance which is employed to prevent the limb, or even the body, from being dragged along by the extending power. The extension is generally made upon that part of the limb which is articulated with the lower piece, and the counter-extension upon that which is articulated with the upper. Thus, for example, in fracture of the shafts of the bones of the forearm, the extending power acts upon the hand, and the counter-extending power upon the arm, while in fracture of the body of the humerus the two forces are respectively exerted upon the forearm and the chest; and so in regard to fracture of the inferior extremity. When but little muscular resistance is anticipated, as in a child or feeble person, the extension and counter-extension may be applied directly to the two fragments, but at as great a distance from the seat of the injury as practicable. On the whole, however, I give the former method a decided preference, as it is much less likely to irritate and worry the muscles.

In reducing a fracture, the injured parts should be put in the most favorable position for relaxing the muscles, and the extending forces should be applied in as slow and gradual a manner as possible. If the limb be suddenly pulled, or stretched by fits and starts, the muscles which are concerned in effecting and maintaining the displacement will inevitably be thrown into violent spasmodic contraction, thus not only causing pain but, perhaps, severe injury to the soft structures, if not actually frustrating our intention. The degree of force which should be used in making extension must vary according to the amount and character of the displacement, and the number and power of the muscles concerned in producing it; in all cases it should be sufficient to remove the shortening of the limb, or, what is the same thing, to restore it to its normal length, and to surmount every obstacle that opposes the reduction. The extension is always begun in the direction of the lower fragment, and is afterwards continued in that of the injured bone, until the object of its application has been attained. The ends of the fragments being now pressed into their natural situation, the fractured part of the limb is enveloped in a suitable bandage, and immovably fixed by splints, every hollow between them and the skin being filled with cotton, to ward off pressure. A sling, to suspend the hand and forearm, completes the dressing, if the fracture occupy the superior extremity.

In fracture of the thigh and leg, the patient lies in bed until the ends of the broken pieces have become completely consolidated, or, at all events, until he has made such progress towards recovery as to admit of the use of the starch bandage, and of exercise in the open air upon crutches. During his confinement, the limb is placed in the most favorable manner for relaxing and resting the muscles which pass over the fracture; for this purpose it should be put in the extended position, and be well secured with apparatus designed to maintain permanent extension and counter-extension. In some cases the limb is placed in the semi-flexed position, over a double inclined plane, but such a course will seldom be necessary or proper, except, perhaps, in fracture of the upper part of the body of the thigh-bone, attended with great and obstinate displacement of the superior fragment, in consequence of the joint action of the psoas and iliac muscles. In transverse fracture of the patella, the thigh and leg are sometimes placed over a single inclined plane, the foot being considerably elevated above the level of the trunk.

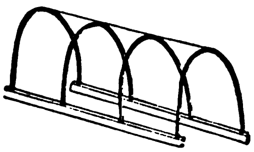
After-treatment.—The fracture having been reduced and dressed, the patient is carefully watched, in order that he may be safely conducted through his long and arduous confinement. His diet, for the first few days should be light and cooling, and the bowels should be opened, if necessary, by some mild aperient, as a dose of castor oil, Epsom salts, or citrate of magnesia. If fever supervene, the antimonial and saline mixture is freely used, aided, if the symptoms are urgent, and the patient is plethoric, by venesection, although such a procedure will rarely be called for. Action having subsided, the patient gradually resumes his accustomed diet, being still careful, however, to err rather upon the side of abstinence than on that of excess. Pain is relieved by anodynes; the bladder, if necessary, by the catheter.

During all this time the fractured limb is carefully watched, the patient being visited for a while at least once a day, or, if the case be at all troublesome, even twice a day, until all danger of mischief is over. If there be considerable pain and swelling, it will be well to remove the dressings at the expiration of the first twenty-four hours, otherwise they may be retained for some time longer. While I am an advocate for the careful watching of the dressings, I am opposed to frequent change, as calculated to produce injurious disturbance in the ends of the broken bone, and impediment in the process of repair. If the first dressings have been applied lightly, as they always should be, and the parts be well seen to afterwards, it is hardly possible for the patient to do badly. The great danger, in nearly all cases, as far as the safety of the limb is concerned, is during the first week; that passed, there is seldom any risk.

In nearly all fractures of the long bones there is apt to be more or less spasm, jerking or twitching of the limb, coming on within the first ten or twelve hours after the accident, much to the discomfort both of the part and system. This is owing partly to the pressure and irritation produced by the ends of the fragments, and partly to the inflammation of the muscles, and is in general easily remedied by the rectification of the displacement, aided by warm applications and a full anodyne, either alone or in union with camphor and tartar emetic. The worst forms of this complaint are met with in nervous, irritable persons, in whom it occasionally persists with great obstinacy, despite our remedies, for a number of days, much to the annoyance of all concerned.

In fractures of the thigh and leg, especially the latter, the limb must be carefully protected from the pressure of the bedclothes, by means of a contrivance, such as that exhibited in fig. 331. It

Fig. 331.



Wire rack for fracture of leg.

consists of two pieces of wood connected by several semi-circles of hoop, or wire, attached by a longitudinal piece.

In fracture of the superior extremity, the patient is often able to walk about immediately after the accident, taking out-door exercise, and, perhaps, even attending to business. But it is very different when he has a broken leg or thigh. Here, as a general rule, he is obliged to keep recumbent, often for a most unreasonable time, until, it may be, he is bedridden, and worn out with suffering. This is wrong. Such a case demands an immediate change of treatment. The starched bandage is substituted for the previous dressings, and the patient is sent out into the open air upon crutches. Prompt amendment follows; the general health rapidly improves, and the process of repair, having received a new impulse, steadily advances to completion.

As fractures are constantly liable to be followed by weakness and stiffness of the limb, the rule is to move the joint nearest the injury as soon as the union is sufficiently advanced to preclude the possibility of displacing the fragments or interrupting the consolidating process. This constitutes what is called *passive motion*, a most important element in the management of this class of lesions. It should not be commenced, as a general rule, before the end of the second week, and should be repeated once a day, or every other day, according to circumstances; it should be very gentle at first, and be gradually increased until the limb has completely regained its normal functions. During its performance the parts are properly supported by assistants, and the dressings are reapplied the moment it is over. The restoration of lost function will be greatly promoted by frequent washing with warm water and soap, followed by frictions with some sorbefacient lotion as spirits of camphor, soap liniment, or weak solutions of iodine.

As soon as the callus has acquired sufficient firmness to sustain the ends of the broken bone, the splints and bandages are either discontinued, or applied more loosely, the object now being merely to keep the parts at rest until the union is perfectly consolidated. In fractures of the inferior extremity, some days should usually elapse before the patient is allowed to rise, or bear any weight upon the affected limb; the new bone is still weak, no definitive callus has yet formed, and the patient, awkward from long disuse of his joints, is liable to fall from the slightest accident. These precautions are extremely important, and should, therefore, always receive the most scrupulous attention.

Immovable Apparatus.—The treatment of fractures of the extremities may often be advantageously conducted with the immovable apparatus, concerning which so much has been said and written of late years as a comfortable and time-saving expedient. When this method of treatment was first announced, in 1834, by Dr. Seutin, of Brussels, it was almost universally regarded with suspicion, and even now, after the numerous trials that have been made with it in different parts of the world, it is questionable whether it is receiving the attention it merits. In this country it has been but little employed at any time, either in private or hospital practice. It is difficult to determine to what this neglect is attributable, whether to fear, to indolence, or to apathy. Many practitioners are afraid that the apparatus will do mischief; others feel themselves incompetent to apply it properly; while a third, and perhaps the most numerous class of all, reject it on account of the supposed trouble attending its use. Such objections are altogether frivolous. The accumulated experience of the profession during the last twenty years is sufficient to convince any one, even the most sceptical, of the safety and utility of this mode of dressing fractured limbs. It is not, of course, applicable to all cases; but if proper judgment be exercised in their selection there are few in which, in some stage or other of their progress, it will not be beneficial. I am myself averse to the early use of the immovable apparatus, convinced that the safest plan is always to wait until there is complete subsidence of the resulting inflammation and swelling. From ten days to a fortnight is a good average period for the commencement of its application; employed earlier, it may induce undue compression, and thus compel removal. I would, then, have an eye to time and circumstances; avoiding premature interference, on the one hand, and too long delay on the other.

The immovable apparatus may be prepared with various substances. all of them possessing more or less, though not equal, merit. Cowper, an English surgeon, employed compresses and bandages, saturated with a mixture of the albuminous part of eggs and wheat flour, which was replaced by Lawrence by powdered chalk. Seutin was the first to recommend starch; Velpeau uses dextrine; Smee prefers gum Arabic and whiting. Gum shellac and glue have also been highly lauded, and of late much has been said in commendation of the plaster of Paris bandage. Of these various articles the starch is perhaps the best; it certainly possesses the advantage of cheapness, and of being easily prepared, applied, and removed, as well as being always easily procurable.

The apparatus of Smee, called the *moulding tablet*, is also an excellent contrivance, nowise inferior to the starch, and but little more expensive. It consists of two layers of coarse, old sheeting, cemented together by means of a thick paste made by rubbing very finely powdered whiting with mucilage of gum Arabic. The sheeting soon dries, without shrinking, into a hard, firm substance, which, with the aid of a sponge and hot water, may afterwards be accurately moulded to the fractured limb, and worn with great comfort and efficiency.

Dextrine is a yellowish white, pulverulent substance, obtained from amylaceous vegetables and plants; it exists in union with fecula, amidine, diastase, and gum, and possesses remarkably glutinous and adhesive properties, well adapted to the object for which it is employed. Besides, it is very cheap, and generally dries in one-sixth of the time that starch does. The only objection to it is the greater difficulty of removing it. It is converted into a paste of the consistence of thin molasses, with equal parts of water and camphorated spirits, the latter being allowed to soak in well before adding the former.

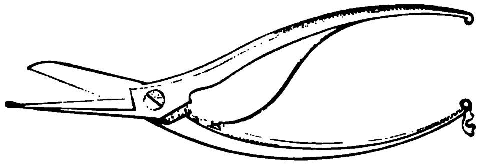
Plaster of Paris, originally employed by the Moors of Spain, was first tried in Europe, as a scientific dressing in the treatment of fractures, by Professor Kluge, of Berlin, in 1829. The bandage is prepared by rubbing the dry plaster thoroughly into the meshes of a thick muslin roller, the ends of which are freely sprinkled with water previously to the application made with as few reverses as possible. The great advantages of this dressing are the rapidity with which it dries and adapts itself to the parts, and the fact that it forms an unusually firm, hard casing, which permits the limb to be handled and moved with great ease during any transportation that may be necessary to place the patient in more comfortable quarters.

The *chalk and gum bandage* forms an excellent substitute for the plaster and starch bandage. It is prepared in the same manner as the latter, over which it possesses the advantage of more rapid desiccation and of greater strength, so as to render a resort to strips of pasteboard rarely necessary. The adhesive mixture consists of equal parts of precipitated chalk and gum Arabic, made into a suitable consistence with boiling water.

The *starch bandage* which I prefer, on account of its simplicity and the facility of procuring it, is thus applied:—Supposing the leg to be the part injured, the first thing to be done is to procure a pint of starch, without any lumps, a bundle of wadding, several long rollers, two light binder's board splints, and an apparatus for maintaining extension and counter-extension until the dressing is perfectly dry. The fragments being accurately adjusted, the limb is surrounded, in its entire length, from the toes to within an inch and a half of the knee, with two layers of wadding, in order to protect its bony prominences from the pressure of the bandage. Special pains, moreover, are taken to fill up the hollows on each side between the ankle and the tendo Achillis. A wet roller is now applied from below up in the usual manner, care being taken not to make the reverses over the edge of the tibia, lest they should occasion unpleasant, if not injurious, compression. A layer of starch is next put on, either with the bare hands or with a paint brush, the substance being well rubbed into the meshes of the cloth. Resuming the roller, it is now carried down the limb as far as its extremity, when the starch is again applied, and so on until three layers have been formed. Two splints, made of binder's board, not too thick or heavy, and accurately shaped to the foot and leg, are steeped in hot water, and, being carefully moulded to the parts, are secured with another roller, also thoroughly saturated and covered with starch. Finally, the dressing is completed by the application of a dry bandage. If the fracture is a very simple one, unattended with any disposition to displacement, as often happens when the tibia alone is broken, the limb is simply placed in an easy position upon a pillow arranged in the form of an inclined plane, or in an ordinary fracture-box; otherwise it will be necessary to use the apparatus of Desault, as modified by Physick, or some similar contrivance, in order to keep up extension and counter-extension until the bandage is completely dried; an event which seldom happens before the expiration of thirty, thirty-six, or forty hours, even in very hot weather, as the evaporation always proceeds with difficulty. The desiccation, however, may often be materially expedited by artificial means, especially by warm sand-bags stretched along the sides of the limb.

When the apparatus is perfectly dry it forms an immovable case for the limb, making equable and uniform pressure throughout, and maintaining the fragments of the broken bone accurately in apposition with each other. If the parts feel entirely comfortable, the patient may now sit up in bed or on a chair, or he may even walk about on crutches, the leg being properly supported in a sling. Generally, however, it will be found that there is for a day or two a sense of soreness, with, perhaps, some degree of throbbing, inviting recumbency rather than the erect posture. If the apparatus causes marked discomfort, by bearing unequally upon any portion of the limb, or if throbbing and swelling arise, immediate measures must be adopted for its removal. For this purpose it should be slit up along the outer side of the limb, about an inch or an inch and a half external to the crest of the tibia, by means of Seutin's scissors, represented in fig. 332, one of the blades of which is probe-pointed, and therefore well adapted to the object. The limb being properly supported by an assistant, the hardened shell is gently peeled off from its surface, which is next carefully sponged with alcohol and laudanum, or spirits of camphor, when the apparatus is immediately reapplied with the aid of a roller. Thus, by simply removing the bandage from time to time, an opportunity is afforded of inspecting the limb, and ascertaining its precise condition, not only at the seat of fracture, but everywhere else.

Fig. 332.

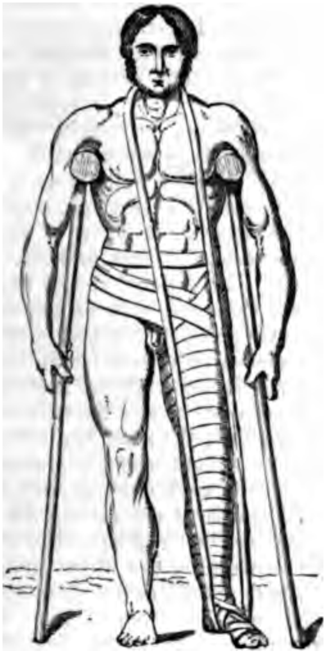


Seutin's scissors.

When the patient is able to move about on crutches, the limb should be carefully supported in a sling, arranged in the manner represented in fig. 333.

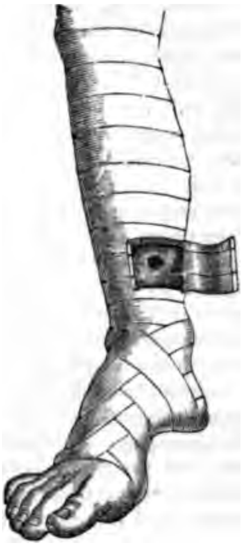
If the fracture be seated high up in the leg, the apparatus should extend a short distance above the knee, as it then becomes a matter of great moment to keep the joint in as passive a condition as possible. In compound fracture, attended with discharge, a hole should be cut in the apparatus opposite the wound, so as to admit of the necessary drainage, as represented in fig. 334.

Fig. 333.



Fracture of the thigh, done up in starch bandage.

Fig. 334.



Dressing in compound fracture of the leg.

Great care should be taken that the edges of the splints do not produce any injurious compression; to obviate this, it is usually recommended that they should be torn instead of being cut, it being alleged that, when treated in this manner, they will be much less likely to create mischief. My own experience, however, is that this is not the fact, and I, therefore, invariably bevel the inner edges with a stout knife, thus effectually preventing all risk of this sort.

It is not possible, also, to bestow too much attention upon the bandage; the care or negligence with which this is applied will make all the difference in the result, both as it respects the patient's comfort and the character of the cure.

The plaster of Paris bandage, prepared in the manner already mentioned, is applied in the same way as the starch, the limb having been previously enveloped in cotton wadding and a dry bandage. Great care is taken with the reverses and the various depressions of the limb. The bandage, moreover, must not be drawn with quite the ordinary firmness, allowance being made for shrinkage. Splints may usually be entirely dispensed with, especially if folded cloths, saturated with plaster, be applied whenever more than usual support is required, but extension must be kept up by assistants until the bandage is perfectly dry, as it always will be in a few minutes.

3. COMPLICATED FRACTURES.

The only class of fractures, besides the simple, which deserves to be considered under a distinct head is the complicated, as it is easy to comprise under this denomination every form of accident that can possibly arise either at the moment of the injury, or during the progress of the treatment. The propriety of this arrangement will become more obvious as we proceed with the discussion of the subject. In adopting this plan, I shall treat successively, and as concisely as possible, of fractures complicated with wounds, hemorrhage, dislocation, comminution of the bone, excessive laceration of the soft parts, erysipelas, pyemia, and, lastly, tetanus.

Complicated fractures may be oblique, transverse, or longitudinal, the frequency of their occurrence being in the order here enumerated. They are always caused by mechanical violence, as gunshot, falls from a great height, severe blows, or the passage of the wheel of a carriage, wagon, or railroad car. Complicated fractures from the latter cause have, of late, become very common, and are a frequent source of loss of limb and life.

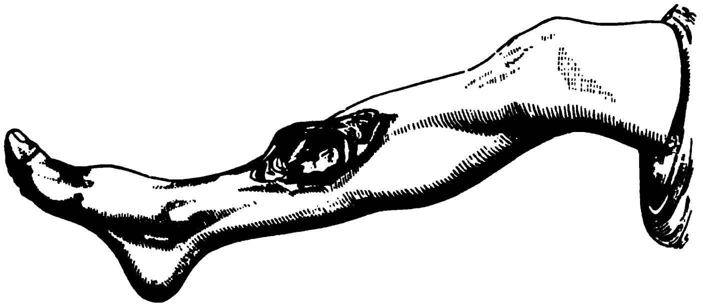
The *symptoms* of this variety of fracture are, like those of simple fracture, sometimes extremely obscure, requiring great care and skill on the part of the surgeon to determine their character. In general, however, they are sufficiently well marked to enable him to distinguish them from such as attend other accidents, especially if an opportunity be afforded him of examining the parts before the supervention of much swelling. There is usually greater pain and shock than in an ordinary fracture, the resulting inflammation is more severe, and there is greater risk of violent secondary effects, as erysipelas, gangrene, copious suppuration, necrosis, caries, prostration, hectic irritation, and tetanus. In fact, complicated fractures are among the most serious occurrences that are met with in practice, being alike perplexing to the surgeon and dangerous to the patient; demanding the nicest judgment and skill for their successful management, and entailing, not unfrequently, the greatest possible suffering, horrible deformity, and loss of limb, if not also loss of life. It may be stated, as a general rule, that complicated fractures of the lower extremity are more dangerous and difficult of management than those of the superior, as well as more apt to be followed by distortion and permanent lameness.

The process of repair in complicated fracture proceeds on the same principle as in the simple form of the lesion, only that it is usually more tedious, and that it is attended with a larger quantity of callus. When there is a wound in the soft parts, the union is generally effected through the medium of granulations, which, arising from the ends of the fragments, ultimately assume the ossific disposition, and thus form the connecting link between them.

The *treatment* of this form of fracture varies according to the circumstances of the case, or the nature and severity of the complication; a fact which imposes the necessity of considering the subject somewhat in detail.

When the case is complicated with a *wound* in the soft parts, constituting what is usually called a *compound fracture*, fig. 335, and the limb is deemed capable of preservation, the first and most important consideration is the reduction of the fracture. This may generally be done by putting the limb in the most favorable position for relaxing its muscles, and by well-directed and gentle efforts at extension and counter-extension, along with proper manipulation, especially if the fracture be transverse, and the opening large; but if it be oblique, and there is a projection of one or both ends of the fragments, they occasionally fail, and compel us to resort to other measures. Under such circumstances, the soft parts which seem to gird or bind the bone, and prevent it from yielding, should be carefully divided, when a renewed attempt at reduction will probably be successful. Should every reasonable effort of the kind, however, prove fruitless, then, instead of leaving the bone in its exposed situation, where it would be sure to die, the proper plan will be to cut away a portion of it, especially if it terminate in a very long and narrow point.

Fig. 335.



Fracture of the leg, complicated with wound and comminution of the bone.

Whatever may be the character of the wound, its edges should be carefully approximated by suture and plaster, aided by collodion to exclude the air; or, instead of this, the wound may be covered with a light compress wet with blood, and supported by a bandage. In this way, a compound fracture may occasionally be speedily converted into a simple one, union sometimes occurring in a few days.

The *hemorrhage* in complicated fracture may be open or concealed, according as there is a wound or no wound; arterial or venous; insignificant or copious. In the first case, the bleeding will manifest itself in the usual manner, and is to be arrested by ligature or compression; in the second, it will be indicated, if it be at all considerable, by unusual swelling, attended with a sense of fluctuation or unusual softness, and by more or less discoloration of the integuments. If the principal artery of a limb has been severed, there will be an absence of pulsation in the parts below, with coldness of the surface. When no doubt remains concerning the diagnosis in such a case, the main trunk of the vessel is exposed some distance above the seat of fracture, and ligated; or, if this be deemed improper, an incision is made through the bloody tumor, and, its contents being turned out, the divided artery is sought and secured above and below the seat of injury. This, in fact, is usually the preferable procedure, especially as there must frequently be considerable uncertainty whether the effusion is arterial or venous; a circumstance which, perhaps, thus leads to the performance of a most serious operation in a case where one of a most simple character might suffice.

When the fracture is attended with a *dislocation*, the case necessarily assumes a very serious character, as it may give rise, especially if the joint involved be a large one, or the bone greatly shattered, to the question of primary amputation. In such an event the most experienced surgeon will often find it difficult to come to a prompt and correct decision. The principal circumstances which should induce him to make an attempt to save the limb are, the integrity of the patient's health at the time of the injury, together with a knowledge of his previous habits, and the simplicity of the dislocation, or the almost total absence of complication, as it respects the affected joint. If, on the other hand, the dislocation is compound, and the bone is badly broken, at the same time perhaps that it protrudes at the articulation;

if all these injuries exist, or if, along with them, serious mischief has been inflicted upon the soft parts, as a violent contusion of the skin and muscles, or the laceration of important vessels or nerves, no doubt can be entertained respecting the propriety of the operation, and the sooner it is performed after the occurrence of reaction, the better it will be for all parties concerned. I believe that a compound fracture, extending into a large joint, as the knee or ankle, and attended with extensive rupture of the ligaments, muscles, and other structures, should always, as a general rule, be treated in this way. It is true a case apparently of the most desperate character occasionally recovers, but such a consideration should not have too much weight, or induce us to neglect a measure which is sanctioned not less by reason than by experience.

When the case is not such as to demand amputation, the dislocation should always be reduced before an attempt be made to adjust the fracture. Great difficulty will sometimes attend such an operation, but this may usually be overcome by patience and perseverance, aided by the means furnished by modern improvement. It is sheer folly to postpone the reduction of the dislocation until the bone has become sufficiently consolidated to enable it to bear the requisite manipulation; one of two things would be almost sure to happen in such a case, either a reproduction of the fracture, or an utter failure to replace the luxated bone.

The most common causes of *comminuted* fracture are, gunshot violence, railroad accidents, falls from a great height, and the passage of the wheel of a carriage. If the bone be broken into several pieces, and any of them are completely detached, or so loose as to render their reunion improbable, all such pieces ought to be carefully removed; after which the edges of the wound should be gently approximated, and kept in position by sutures and adhesive strips, covered with collodion. The limb being surrounded by the bandage of Scultetus, and supported by appropriate apparatus, is placed in an easy position, care being taken to moderate inflammation by the usual antiphlogistic means. If the wound suppurates, it must be covered with an emollient poultice or the warm water-dressing, with as little disturbance as possible to the broken bone.

When the fracture is complicated with violent *contusion* of the soft structures, the retentive apparatus should be applied rather slackly, and the parts be kept constantly wet with cold water, or, what is better, a strong solution of acetate of lead and opium. If the inflammation run high, recourse may be had to bleeding, purgatives, and antimonials. The limb is carefully watched, in order that prompt advantage may be taken of any change as soon as it arises.

In consequence of injury sustained by the skin, either at the time of the accident, or from the pressure of the bandage, the cuticle is sometimes raised into little *vesicles*, filled with a thin, limpid, reddish, or yellowish fluid. Such an occurrence always awakens anxiety both in the patient and practitioner, especially if he be young and inexperienced, as it is apt to be associated with the idea of gangrene. From this, however, it may always be easily distinguished by the absence of lividity, severe pain, and other symptoms of excessive action. The proper treatment consists in puncturing the vesicles with a fine needle, and using the warm or cold water-dressing.

If the principal artery, vein, or nerve of a limb has been destroyed, at the same time that there is extensive laceration of the soft parts around, the case will probably require amputation, especially if there has been severe shock or extensive hemorrhage, with previous derangement of the general health. Such a case is, at all events, a bad one, liable to be followed by loss of limb, if not also of life. If, on the other hand, the principal artery retains its integrity in the midst of the torn and broken structures, and the patient is young and vigorous, although he may have bled severely, we should by all means make an attempt to save the limb, having previously explained to the patient and his friends the risk which such an undertaking involves. Some of the most gratifying results that reward the care and skill of the practitioner are cases of fracture complicated with extensive laceration of the soft structures and comminution of the bone. I have several times succeeded in effecting excellent cures when, the main artery being intact, the limb hung merely by a comparatively small quantity of skin and muscle, and when I was compelled to remove a number of pieces of bone, or even saw off the ends of the fragments.

Accidents after Complicated Fractures.—The most common and important accidents after complicated fractures are erysipelas, œdema, abscess, gangrene, spasm, tetanus, pyemia, delirium, and congestion of the brain and lungs.

Erysipelas usually comes on within the first forty-eight hours after the occurrence of the injury. The disease is most apt to appear in persons of intemperate habits, and in such as are dyspeptic, or enfeebled by previous suffering, and generally adds very much to the danger of the case, perhaps already great before. Its extent and continuance will depend upon various circumstances, which will readily suggest themselves to the mind of the reader. The treatment is conducted upon general principles, our main reliance being upon the correction of the secretions, and the support of the system, by quinine, iron, milk-punch, nutritious food, and anodynes, with the topical application of tincture of iodine diluted with equal parts of alcohol.

The occurrence of *œdema* is sufficiently common in complicated fractures of old, dilapidated subjects, and is best remedied by the bandage, aided by spirituous lotions, tonics, and a nutritious diet. Punctures will seldom be necessary, and should always be used with the greatest caution.

Abscesses, diffuse, painful, and troublesome, may form either at the seat of the fracture, or in its immediate vicinity. In either case, the matter should be speedily evacuated; otherwise it may not only cause extensive havoc among the soft parts, but caries and necrosis of the ends of the broken bone, with risk of pyemia and phlebitis.

Gangrene may be produced by injudicious bandaging obstructing the circulation, excessive inflammation, or injury of the main artery, vein, or nerve of the affected limb. The occurrence is most liable to happen in unhealthy subjects, and in young persons after railroad and other severe accidents, and often makes fatal progress before its presence is suspected by the patient or his attendant. Great pain in the part of a smarting, pungent, or burning character, accompanied with discoloration and tumefaction in the distal portion of the limb, should always excite alarm and lead to a thorough examination. Tight bandaging in particular should be avoided in complicated fractures, especially in the early stages of the treatment.

Severe *spasm* frequently attends this class of injuries, but as this subject has already been discussed in connection with simple fractures, nothing further need be said respecting it here.

Pyemia, as an effect of complicated fracture, is uncommon, at least in private practice, except when the accident has been caused by railway injury, the bursting of a gun, the passage of the wheel of a wagon, or some similar violence. It is distinguished by its usual insidious character, and generally sets in from the fifth to the tenth day, its approach being announced by violent rigors, alternating with flushes of heat, great depression of the system, delirium, and excessive restlessness. The structures which are most apt to suffer are the lungs, liver, spleen, joints, and connective tissues. The treatment is supportant and alterant; by quinine, brandy, and nourishing broths, for the former; by mercury, in moderately large and properly sustained doses, for the latter. In general, such cases fare badly, death occurring within a week from the commencement of the attack, despite our best directed efforts.

Tetanus in complicated fractures, is most liable to supervene in nervous, irritable subjects, during hot weather, although it may take place at any season of the year, as well as in every description of individuals. It is an extremely formidable symptom, which should be promptly met by the removal of the affected parts, and by large quantities of anodyne and antispasmodic remedies. If occasionally a case is cured without amputation, it forms the exception, not the rule. In such an event, there is no time for delay; whatever is done must be done quickly and effectively, at the very inception of the disease, before there is any decided evidence of stiffness in the muscles of the jaw.

Traumatic delirium is sufficiently frequent after these accidents, especially in old intemperate persons, and should be treated upon the principles laid down in a previous chapter.

Congestion of the lungs and other internal organs, as a consequence of these injuries, is most liable to occur in elderly persons, as a result of a determination of blood either from actual irritation or a sluggish condition of the vessels from protracted confinement. As such attacks are very apt to prove disastrous, everything should be done to prevent them, by getting the patient as speedily as possible out upon crutches in the open air.

Amputation.—Allusion has already been incidentally made to the circumstances which are likely to call for *primary amputation*, and it may now be added that it should always be resorted to, as a general rule, whenever, along with a shattered or comminuted condition of the fractured bone, there is extensive laceration of the soft parts, with almost total disorganization of their substance. It is true, as was before intimated, that apparently desperate cases are sometimes cured, and that limbs, so mashed and wounded as to render amputation the only probable chance of success, are now and then saved. But it is equally true that such instances are extremely rare, and if we take into account the protracted sufferings of the patient, and the likelihood of his ultimately falling a victim to his ailments, the reasons for performing immediate amputation are, to use the language of Mr. Percivall Pott, "vindicable upon every principle of humanity or chirurgic knowledge."

It is not uncommon for cases to occur in which the fracture is *multiple*, or in which the bone is broken at several points, but where the upper fracture is perfectly simple, and perhaps situated in a portion of the limb which it is desirable to preserve. Hence it becomes an important question how the surgeon is to act in such an event. To my mind, the subject is a very plain one. If it be really important to save the broken bone beyond the part that must necessarily come off, in order to make a longer and a better stump, there can certainly be no objection to such a course, provided, however, that the proximal fracture be perfectly simple in itself, and that there is no serious lesion of the soft structures, endangering limb and life by gangrene or other bad consequences. I have more than once adopted this plan, and have not, so far as I recollect, had any cause to regret it. No sensible surgeon would, of course, allow a bone to remain, under such circumstances, if it were comminuted, or if, the fracture being simple, there were serious injury of the muscles, integuments, or other important textures; to do so would only be to trifle with the safety of the case.

Secondary amputation will be necessary when, after an attempt to save a limb, and the employment of suitable antiphlogistic remedies, the parts become gangrenous; or when the consolidation of the fracture is prevented by profuse suppuration, and the patient is gradually wearing out by diarrhœa and colliquative sweats. In the first case, the operation is performed as soon as the mortification is arrested, and there is a distinct line of demarcation between the dead and living parts; in the second, as soon as it is perceived that the suppuration cannot be arrested, and that the patient has still sufficient strength to bear the pain and shock which must necessarily attend its performance.

Statistics of Compound Fractures.—We have no very copious statistics of compound fractures of different parts of the body. The following account, for which I am indebted to Dr. Frederic D. Lente, relates to cases of compound fractures of the lower extremities, treated in the New York Hospital from January, 1848, to July, 1857, the whole number being 392, fractures of the tarsus and metatarsus not being included. Of these, 68 occurred in the thigh, and 324 in the leg. Of the former, 3 involved both thighs, and of the latter, 16 both legs. Of the entire number, 190 were cured, 182 died, and 20 were relieved. In 39, or 20.5 per cent., amputation was performed.

Of the 68 fractures of the thigh, 18, or 26.5 per cent., were cured, and 2 relieved; amputation having been performed in 7. Of the 324 fractures of the leg, 175, or 54.0 per cent., were cured, and 14 relieved. In 35, or 20.0 per cent. of these, the limb was removed. Of the whole number of cases of fracture, amputation was employed in 91, or 23.3 per cent., and of these 49, or 53.8 per cent., died.

Of 301 cases treated without amputation, 140, or 46.5 per cent., died, 3 having refused to submit to amputation.

Of the whole number of fatal cases, in which amputation was not performed, 74, or more than one-half, died within the first week; in many of these there was no reaction, and death ensued in from twenty-four to forty-eight hours.

Of 45 fractures of the thigh which occurred at or below the middle, 14 recovered, or 31.1 per cent.; while of eleven that occurred further down, 4, or 36.3 per cent., recovered.

Of 227 fractures of the leg, occurring at or below the middle, 130, or 58.1 per cent., recovered; of 30 above the middle, 17, or over one-half, got well.

Of 334 compound fractures of the thigh and leg, 164 occurred on the right side, and 170 on the left.

4. INCOMPLETE FRACTURES, OR BENDING OF THE BONES.

The bones are liable not only to break, but also to bend, as seen in figs. 336 and 337. Such an accident can only happen in young subjects, principally in infants and children, in whom the osseous tissue, containing a preponderance of animal matter, is comparatively soft, flexible, and elastic. Bending of the bones of the skull, especially the frontal and parietal, is occasionally witnessed at an early age, as an effect of external violence, as that, for instance, produced when a child falls, head foremost, down a flight of stairs, or out of a second story window upon the pavement below. Under such circumstances, the cranial bones, at the part struck, are depressed beyond their natural level, and yet there is not, so far as can be ascertained, any fracture,

Fig. 336.

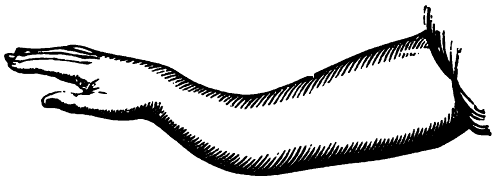
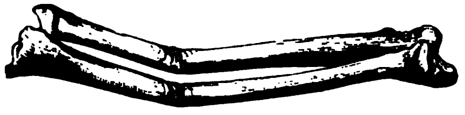


Fig. 337.



Incomplete fracture of the bones of the forearm.

strictly so called; they are merely bent or indented, and if no untoward occurrence take place, they will, generally in the course of a few days, resume their proper position by their own resiliency, aided, doubtless, by the locomotive action of the brain, propelling them outwards away from its surface. In an adult, an accident, capable of producing such a result, would almost certainly lead to fracture of the skull, and that probably of a very grave character; for the reason that the cranial bones, after a certain time, are always loaded with a large quantity of earthy matter, in the form of carbonate and phosphate of lime, the presence of which renders them more or less brittle, and thus predisposes them to fractures. This tendency to fracture increases in proportion as we advance in years, and is, consequently, most distinctly marked in old age and decrepitude, in which the osseous tissue, almost destitute of animal substance, generally yields under the slightest force, the accident frequently eventuating in incurable injury.

Bending of the bones had been incidentally observed by a considerable number of practitioners, in the last century, and, indeed, even prior to that period; but the first systematic account of it was published in 1810, by Professor Jurine, of Geneva, Switzerland. In 1821, a short, but valuable article, illustrated by several graphic drawings, appeared on the subject in the fourth volume of the American Medical Recorder, from the pen of Dr. John Rhea Barton, of this city. More recently, attention has also been called to the affection by Professor Hamilton, in his Report on the Deformities of Fractures, made to the American Medical Association in 1855, and also in an article in the New York Journal of Medicine for November, 1857.

I have myself met with this accident in nine cases, in children whose ages varied from three to eleven years, three being girls, and the remainder boys. Although it is most common in the ulna, radius, and clavicle, yet it also sometimes occurs in other pieces of the skeleton, as the humerus, femur, tibia, fibula, and ribs. External violence alone is capable of producing this lesion. I am not acquainted with any cases in which it was occasioned by muscular contraction. In fact, considering that bending of the bones is exclusively confined to children, it is hardly possible that the accident could arise from such a cause; certainly not, unless there existed extraordinary muscular development with remarkable flexibility of the osseous tissue, a condition of things hardly compatible with a healthy state of the system. In the bones of the forearm, which suffer more frequently than any other, the injury usually originates from force applied indirectly, as when, for example, a child, in the act of falling, instinctively throws out the arm to protect the body, and so receives the shock upon the hand, the concussion concentrating and exploding upon the radius, or the radius and ulna. In one of my cases, the bend was produced by the body of the child being suddenly propelled against his forearm at a moment when the elbow was planted upon the floor, and the wrist lying upon a stool. Flexion of the clavicle is the result either of direct violence, or of force applied to the top of the shoulder, especially if the body be at the same time propelled in the opposite direction, as in the case of a fall.

The *seat* of this lesion is variable; in the long bones, as those, for instance, of the forearm, it usually occurs a short distance below their middle, but it may also take place higher up, or further down. The radius and ulna may both suffer synchronously, but very frequently one alone is affected, or, if both are implicated, they do not suffer in an equal degree.

Judging from the cases of this accident that have fallen under my observation, I am inclined to believe that it generally happens without any particular predisposition, either constitutional or local. In every instance of the kind, the subjects of the injury were in good health at the time of its occurrence.

What is the precise *nature* of this lesion? Is it really, as the name implies, a mere bending of the bones, or is it a flexion combined with partial fracture? These questions are easily answered. In very young subjects, as in children not more than a few years of age, and in the milder forms of the lesion, the osseous fibres are merely extended or stretched, so as to permit themselves to be drawn out of their natural course; in cases of an opposite character, on the other hand, there is no doubt that, while some of the fibres are bent, others are both bent and broken. These conclusions are beautifully borne out by the experiments of Dr. Hamilton upon the bones of young chickens, which, from the fourth to the sixth week, and consequently before the completion of the ossific process, could be readily bent without fracture to an angle varying from twenty-five to thirty-five degrees; whereas, the bones of older chickens, thus treated, always partially broke, their fibres being incapable of withstanding the force used in flexing them.

These partial fractures, sometimes called *interperiosteal*, from the fact that the fibrous envelop of the bones remains intact, bear a close resemblance, in the mode of their production, and the nature of the resulting injury, to the appearances presented by a green hickory stick, forcibly bent over the knee, but not to such an extent as to occasion any external sign of fracture, although it will be found, upon making a section of the wood, that many of its fibres have actually been broken, while others, and perhaps the greater number, have merely been bent.

The *symptoms* attendant upon this accident are pain and deformity at the seat of the injury, loss of power in the limb, and absence of crepitation. The pain varies in degree, being sometimes slight, at other times severe; swelling soon supervenes, and the part feels numb and heavy. A marked curvature, generally very gentle, but sometimes quite abrupt, always exists at the affected part, and can seldom be completely effaced without the application of very considerable force; indeed, often not without breaking the bone entirely across, especially if it was previously partially fractured. In the latter case, there is usually at the convexity of the curvature a slight depression, capable of receiving the point of the finger, its boundaries being formed by rough, sharp, bony fibres. Further than this there is no displacement, and under no circumstances is there any crepitation. The use of the limb is always greatly impaired, but not completely destroyed, as it commonly is in ordinary fracture. Finally, I may mention, as another highly important and diagnostic sign, the great difficulty which is so frequently experienced in restoring the parts to their proper position.

The *treatment* of these accidents must be conducted upon the same general principles as that of ordinary fractures. When the bones are merely bent, slight pressure and extension will usually suffice to accomplish restoration, the affected parts being compelled, as it were, to retrace their former steps. If flexion be conjoined with partial solution of continuity, the reduction will necessarily be more difficult, and may, in fact, altogether fail, owing to the manner in which the osseous fibres are interlocked with each other, and the inability which is experienced in disengaging them, so as to induce them to slip back into their proper position. However this may be, the attempts to remove the curvature by extension and pressure should neither be too violent nor too long continued, lest they prove injurious. The object should be to restore as much as we can by gentle means; what cannot be effected in this manner, may well be left to the operation of time, the absorption of the broken and resisting osseous fibres, and the action of the muscles, which seldom fail to reinstate the parts, although from six to eight weeks may elapse before the final completion of the cure. I have generally found the use of leather splints, well padded, and accurately shaped to the limb, of great service in bringing the bones into their proper relations. When the accident is followed by undue inflammation, recourse must be had to the usual antiphlogistic remedies, especially leeching and cooling lotions.

There is a variety of partial fracture, known by the term *fissure*, which is peculiar to the bones of elderly subjects, no well-marked instance of it having ever been met with in infants and children. Such an occurrence, which is, in general, much more interesting in a pathological than in a practical point of view, is by no means uncommon in the skull, especially along its base, where it is always associated with severe, and frequently fatal, injury of the brain and its envelops. The fissures in many of these cases are most extensive, involving the sphenoid, occipital, temporal, frontal, and perhaps even the ethmoid and parietal bones. In the other pieces of the skeleton the occurrence is more rare; but examples are occasionally seen both in the long, short, and flat bones, as the result of external violence, generally directly applied, though sometimes indirectly. The accident is sometimes produced by gunshot injury. The lesion, however induced, consists essentially in a forcible separation of the osseous fibres, and exhibits itself in a great variety of forms; the crack sometimes extending through the entire thickness of a bone, at other times merely through its outer table, and at other times, again, involving both the compact and areolar tissues, but not passing completely through them. The length of the fissure varies, from a few lines to a number of inches, perhaps as many as six or eight, although this is exceedingly uncommon. The width of the crevice is generally very slight, perhaps barely sufficient to admit the blade of a penknife. In rare cases, as when it involves the extremity of a bone, it may gap somewhat, so as to give the part an appearance as if it consisted of two fragments, firmly adherent at one end. Finally, the fissure may be straight, curved, or angular.

Of the rarity of this lesion, as an uncomplicated occurrence, an idea may be formed when it is stated that there are probably not more than three or four well-marked specimens of it in all the osteological cabinets of this city. As a conjoint lesion, it is occasionally met with in compound fractures, especially when caused by railway accidents. There are no signs by which the nature of the injury can be distinguished during life; a circumstance which is the less to be regretted, because the treatment does not differ from that of ordinary wounds, fractures, and contusions, with which it is so generally associated.

5. DIASTASIS OR SEPARATION OF THE BONES AT THEIR EPIPHYSES.

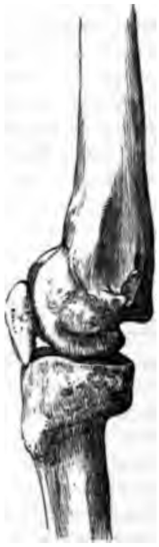
The extremities of the bones of young subjects are, as is well known, united to their shafts, or bodies, by means of cartilaginous matter, which, in some of the pieces, and in some individuals, does not assume the osseous form until after the twenty-first year, and occasionally, indeed, not until even a later period. Up to this time, consequently, these junctions are liable to be severed, so as to allow the contiguous extremities to separate from each other, and it is this occurrence that constitutes what is technically called diastasis, as seen in fig. 338.

It is probable that this accident may occur in all parts of the skeleton united in this way, although there are doubtless some in which it is more common than in others. Its occasional existence has been recognized, by dissection, in the humerus, radius, femur, and tibia, and there are few systematic treatises which do not allude to it as being now and then met with in some of the other bones. The most common cause of diastasis is a wrench of the part, violent traction, or a severe fall. I am not aware that it has ever been produced by muscular contraction; and, on the other hand, it is rarely the result of direct violence, as, for instance, the kick of a horse, or the passage of the wheel of a carriage, such an accident more generally eventuating in fracture of the bones than in a separation of their epiphyses. The lesion may happen at any period of life, prior to the completion of ossification, but is most common from the fifth to the fifteenth year. Its occurrence in middle-aged and elderly subjects is, for the reasons already mentioned, impossible. Girls are more prone to it than boys, owing, probably, to the fact that they are more frequently exposed to its exciting causes. The affection, like fracture, may be simple, compound, or complicated. Cases are noticed in which the diastasis is blended with fracture of the shaft of the bone, and it is by no means uncommon to find that small processes of bone are dragged away with the epiphyses.

The *symptoms* of this lesion do not differ essentially from those of fracture. Its existence may generally be suspected when an accident affecting a bone occurs in a young subject, in the neighborhood of a joint; when the ends of the fragments are transverse, or nearly so; when the articular piece retains its position, while the other moves about; and lastly, when the crepitation produced by rubbing the ends of the fragments against each other is of an unusually dull, rough, grating character. Moreover, it will usually be found that the parts, when once reduced, are less liable to be dragged asunder by the action of the muscles than in case of fracture.

The prognosis is generally favorable, union taking place quite as promptly as in fracture. The treatment is also the same as in the latter accident.

Fig. 338.

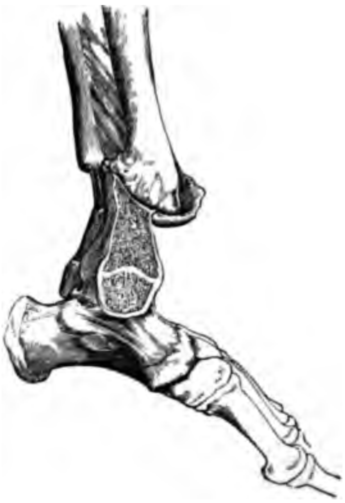


Diastasis of the femur: reunited.

6. UNUNITED FRACTURES.

Fractures occasionally refuse to unite, either in consequence of causes inherent in the part or system, or on account of mismanagement growing out of the surgeon's want of attention and skill, or else out of the patient's own misconduct. It is practically important that a distinction should be drawn between a fracture that unites tardily and one that does not unite at all, or only through the medium of a fibrous, ligamentous, or fibro-cartilaginous tissue. Slow consolidation is by no means uncommon; the parts may be loth to take on the requisite degree of ossific action, and the result may be that a fracture that is ordinarily repaired in four or five weeks, may, perhaps, be still imperfectly united at the end of twice that period. The process of restoration is only held in abeyance, neither advancing nor receding; by and by it begins again, and then often proceeds with its wonted rapidity. Such cases are frequently very trying to the surgeon's patience, but they generally turn out well in the end, provided sufficient care has been taken to preserve the parts in their proper relations. In the ununited

Fig. 339.



Ununited fracture of the bones of the leg.

fracture, on the other hand, the process of consolidation is either completely prevented, or, after having progressed for some time, is at length permanently arrested. Under these circumstances, the ends of the fragments are gradually rounded off by absorption, and remain either entirely loose and disconnected, or they become adherent through the medium of fibrous, ligamentous, or fibro-cartilaginous matter. Sometimes an adventitious joint is formed, as in fig. 339, provided with a more or less distinct synovial membrane, thus permitting the ends of the bone to move upon each other with great facility.

Want of reunion in a fracture may depend upon a great variety of *causes*, some of them resident in the parts themselves, others connected with the system. Thus, it may be occasioned by the interposition of a clot of blood, or of a piece of muscle, tendon, or bone. An instance is mentioned where a fracture was prevented from becoming consolidated by the presence of a musket ball. Fragility, softening, and carcinomatous affections of the bones are usually enumerated as circumstances interfering with the reparative process, but it is not improbable that their influence has been greatly exaggerated; at all events, it is certain that in many cases of this kind, the fracture unites as readily as when the bones are perfectly healthy. Too much motion, the long-continued use of cold water, especially in persons of a nervous, irritable temperament, and tight bandaging, may also bring about this result. Some years ago, I saw a case in which, from the latter cause, the consolidation of a fracture of the thigh-bone was delayed for nearly a twelvemonth. The limb had become excessively atrophied from the long-continued and injudicious use of the roller, and it was not until after it had been entirely laid aside, and the man had been permitted to exercise upon crutches in the open air, that nature seemed to consider herself in a fit condition to commence the process of reparation, from which she had been so long detained by this mode of treatment.

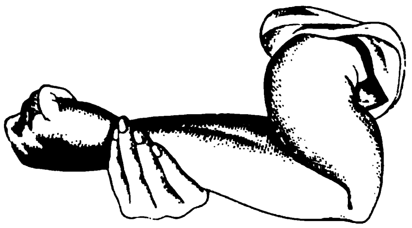
Old age is no barrier to reunion, provided the patient is in good health at the time of the accident, and the fracture is not complicated. I have met with several cases of fracture of the humerus, in persons after the eightieth year, in whom the consolidation took place in the usual time.

But the most common local causes of all of tardy reunion, in injuries of this kind, are a want of accurate apposition between the ends of the fragments and the existence of undue motion. Either of these circumstances will inevitably interfere with the consolidating process, and in many cases effectually prevent it, no matter in how favorable a condition the system may be for a cure. Hence, as stated elsewhere, the importance, nay, the absolute necessity, in every instance of fracture, of carefully guarding against these occurrences until the consolidating process shall be so far advanced as to enable the fragments, so to speak, to take care of themselves.

Fractures situated at or near the entrance of the nutrient arteries unite less rapidly than those situated further off, owing to the fact that they interfere more or less with the circulation and nourishment of the osseous tissue. It is easy to suppose that a laceration of these vessels, as occasionally happens both in simple and compound fractures, might be a cause of non-consolidation, especially when conjoined with other unpropitious circumstances. Statistics show that, when the supply of blood is cut off, to any considerable extent, so as to impose upon the periosteum the exclusive duty of nourishing the fragments, either one or both pieces will become atrophied, their walls being visibly thinned, and their areolar structure rarefied.

Want of union is sometimes dependent upon the *absorption* of the ends of the fragments, or even of the greater portion of the fragments themselves. A very singular case of this kind came under my observation not long ago, in a man aged 53 years. When eighteen years old, he received two simple fractures of the right humerus, at an interval of three months, one being situated about the middle of the bone, the other an inch and a half higher up. The first was repaired in the usual time, but the second refused to unite, the ends of the fragments becoming rounded off, as in the formation of an artificial joint; the process gradually proceeding, the whole bone was finally absorbed, nothing remaining except its condyles and a little of its head. The period occupied in the absorption was about six years, the general health being all the while unimpaired. The muscles of the arm are well developed, and, when thrown into powerful action, are capable of diminishing the interval between the shoulder and elbow to the extent of several inches. Although the man is unable to perform any of the usual movements of the member, he can readily raise a weight of upwards of one hundred pounds, and can apply his hand to various purposes. The accompanying cut, fig. 340, represents the appearance of the limb during the contraction of its muscles.

Fig. 340.



Absorption of the humerus.

The principal *constitutional causes* which interfere with the reparative process are, debility, whether from loss of blood, want of nutritive action, or exhausting disease, as long-continued fever; a gouty, rheumatic, scorbutic, or syphilitic state of the system; and loss of nervous influence, however induced. Another cause, but one which, I presume, seldom exerts much influence, is pregnancy. It is barely possible to imagine that, during this state, there may be such an abstraction of blood from the affected parts for the nourishment of the fœtus as to retard, and, perhaps, even temporarily prevent, the formation of callus. In the few cases of this kind which have fallen under my observation, I have not, however, witnessed such an effect, and I am strongly inclined to believe that this influence has been greatly magnified, if, indeed, it is not almost wholly chimerical. The same remarks are applicable to suckling. Another cause, probably much more efficient, as well as much more common, than the one just alluded to, is the protracted and inordinate use of ardent spirits, weakening the nutritive energies of the system, and rendering the blood and its vessels unfit for the performance of the important duties assigned to them in the reparative process.

Whatever the cause may be, great pains should always be taken to discover it, with a view to its early and efficient rectification. Should it consist in debility, however induced, the patient must at once be put upon the use of nutritious food and drinks, as porter, ale, wine, or brandy, aided, if necessary, by tonics, of which iron and quinine are generally the most eligible. A gouty or rheumatic state of the constitution is best remedied by purgatives, acid drinks, and colchicum. Tertiary symptoms should be met by iodide of potassium, either alone or in union with mercury, the latter of which should sometimes be carried to the extent of slight ptyalism. Debility from drunkenness must be counteracted by the judicious employment of ardent spirits, such, if possible, as the patient has been in the habit of using previously to the accident.

The local treatment must be regulated by the circumstances of each particular case. The precise cause of the tardy or imperfect union must, if possible, be clearly ascertained, and immediately remedied by appropriate measures. If it depends upon too much motion, greater quietude must be insured; any defect of contact must be redressed by a more accurate adjustment of the ends of the fragments; cold applications, if injurious, must be discontinued; and any extraneous intervening substance must be removed, either by calling into requisition the agency of the absorbent vessels, by pressure and other means, or, as in the case of a piece of dead bone, by the knife and forceps. The cause of the defective union having been thus remedied, the case will be likely, of its own accord, to proceed to a favorable termination, the ordinary principles of treatment being, of course, observed.

The principal local remedies, besides those above mentioned, are: 1. *Cutaneous friction*, either dry or moist, by means of the bare hand, or with a piece of flannel. If moist, various liniments, lotions, or unguents may be employed, and often with decided benefit, inasmuch as they tend to excite capillary action in and around the ends of the fragments, thus promoting the formation of callus.

2. *Compression* performed by splints of leather, or binder's board and the bandage; or by an apparatus expressly constructed for the purpose, and intended to concentrate the pressure at the seat of the fracture. The compression must, in all cases, be steady and persistent, as well as uniform and gentle.

3. *Blisters* and *iodine* may sometimes be beneficially employed. Their application is particularly indicated when the want of union is dependent upon undue vascular excitement, and is, of course, entirely restricted to cases of recent standing.

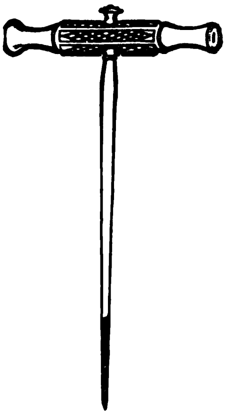
4. *Friction* of the ends of the fragments against each other, as recommended by Celsus, and practised by modern surgeons. It should be performed very gently, and be repeated every four, six, or eight days, according to its effects, care being taken to keep the limb at rest in the intervals by an appropriate apparatus.

5. *Acupuncturation* with a long slender needle may be tried; or a small incision may be made over the seat of the injury, and a heated wire thrust between the ends of the fragments.

6. *Cauterization* of the integuments over the seat of the fracture with some caustic alkali, as recommended and successfully employed, in 1805, by Dr. Hartshorne, of this city; or exposure of the ends of the bone, and rubbing them over with nitrate of silver, as practised by several modern surgeons.

7. *Subcutaneous division* of the ligamentous bands between the two ends of the fragments has occasionally been successfully practised. The operation is performed with an ordinary tenotome, care being taken to cut the parts as thoroughly as possible, especially over the extremities of the broken pieces.

Fig. 341.



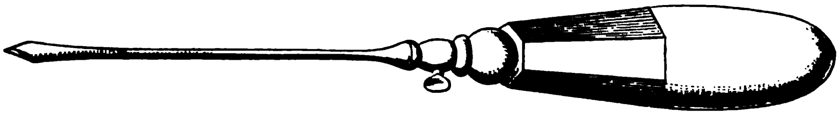
8. The introduction of *ivory pegs*, as originally practised by Dieffenbach, from an inch and a half to two inches in length, conical in shape, and inserted into the ends of the fragments, previously pierced with a gimlet, seen in fig. 341. They must be forcibly driven into the openings, and be retained until the consolidating process is well advanced. Excellent and rapid cures often follow this plan, as I have witnessed in several instances in my own practice.

9. The *seton*, introduced into practice in 1802, by Dr. Physick, is ordinarily, in obstinate cases, the most certain method. It should be passed between the ends of the fragments by a long, thin, flat needle, sharp and lancet-shaped at the point; or when this is impracticable, as near the site of the fracture as possible, for experience has shown that this mode of performing the operation is nearly as successful as the usual procedure. The foreign body is retained for a variable period, longer in some cases than in others, and generally until it has excited suppurative action. The patient is carefully watched; and if the pain and swelling become severe, the seton is

at once withdrawn. Immediately after the introduction, the fragments are properly adjusted, and steps taken, if necessary, to maintain extension and counter-extension. In the first case in which this treatment was employed, the seton was retained many weeks, and the patient recovered the perfect use of his limb. The practice of withdrawing the seton at the end of a few days, as advised by some, is, I think, objectionable, for the reason that it will hardly have sufficient time, in such a case, to excite the requisite degree of inflammatory action.

10. *Perforation* of the ends of the bone by means of a peculiar instrument, fig. 342, an operation proposed, in 1853, by Professor Brainard, is sometimes serviceable. It consists in piercing subcutaneously the extremity of each fragment at several points, and cutting up the intervening tissue, with a view of exciting ossific action. The instrument is introduced in such a manner as not to wound any important structure, and is not withdrawn until the bone has been deeply, and, if need be, even extensively drilled, compression being applied to prevent subcutaneous hemorrhage. The operation is repeated once a week, or every ten days, until reunion has occurred, the limb being in the meantime kept quietly at rest in splints, and the treatment being in other respects conducted upon general principles.

Fig. 342.



Brainard's perforator, reduced one-half.

Dr. Brainard's plan is always to begin the treatment with a small instrument, and to make only three perforations. The size of the former and the number of the latter are afterwards gradually increased until he succeeds in exciting more or less tenderness, pain, and heat in the parts, which are then kept up for some period. In favorable cases, a single operation may suffice; in others, it may be necessary to repeat it four, six, or even eight times. By carrying out these rules, Dr. Brainard states that he had, up to May, 1860, cured sixteen out of seventeen cases of ununited fractures or delayed union.

11. Finally, *excision* of the ends of the fragments, an operation devised, and first performed in 1760, by Mr. White, of England, is occasionally employed. Such an operation, however, should never be resorted to without due deliberation, and until after the failure of the more ordinary and simple means. To say nothing of the difficulty of its execution, it is by no means devoid of danger; indeed, it has not unfrequently proved fatal. A very free incision is made through the soft parts down to the ends of the broken bone, which are then brought out at the wound and retrenched, either with a stout knife, a saw, or a pair of pliers. Sometimes the mere removal of the cartilaginous crust is sufficient for the purpose, an object which may be easily accomplished by scraping.

To maintain the freshened ends in accurate and steady apposition, it was proposed by Horeau, in 1805, to connect them together by means of a wire, and to retain them in this position until the completion of the cure. The procedure, which has, I believe, been generally condemned by European practitioners, has been frequently employed in this country, in consequence, apparently, of the high authority of Dr. J. Kearney Rodgers, who was the first to perform it on this side of the Atlantic. It consists, first, in cutting off the rounded ends of the fragments; secondly, in drilling a hole through each; and lastly, in tying them firmly together with a silver wire, so as to keep them closely and evenly in contact during the consolidating process.

It is generally imagined that this procedure is necessarily followed by violent inflammation, jeoparding both limb and life; but this is an error. If the operation be carefully performed, and the after-treatment conducted upon proper principles, I believe that it will commonly be found to be entirely free from danger, while the utmost confidence may be placed in its efficacy. In the only instance in which I have had an opportunity of employing this method—in a case of ununited fracture of the humerus of eleven months' standing, in a young man twenty-two years of age—the patient experienced very little pain, inflammation, or fever, during any stage of the treatment, and the result was, in every respect, most satisfactory. The following is an outline of this case, as drawn up by Dr. S. W. Gross, for the Louisville Medical Review, July, 1856. It may be premised that the fracture was situated about three inches above the condyles, and that various remedies, among others Dr. Brainard's, had been faithfully but fruitlessly employed for its relief.

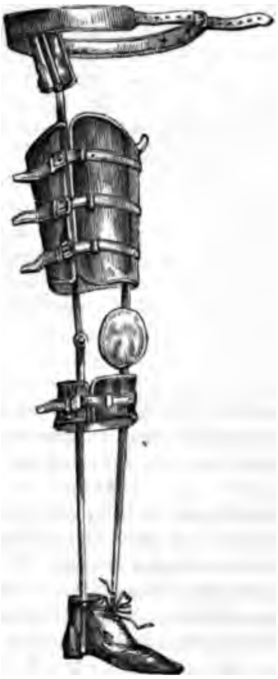
The patient being placed under the influence of chloroform, a longitudinal incision, about three inches in length, was made on the posterior aspect of the arm, through the triceps muscle, over the site of the fracture. The lower fragment was found to overlap the upper about an inch and a half. The ends of the bone were surrounded by a strong fibrous membrane, which was firmly adherent to the neighboring parts, and formed a sort of shut sac, in which the bone was imbedded. About an inch of the lower portion of the upper fragment, and half an inch of the upper portion of the lower fragment, were removed with a delicate saw; but on account of their firm adhesions, and especially the shortness of the inferior piece, some difficulty was experienced in bringing them entirely into view. The fragments were conical, rounded, smooth, and invested with a thick, fibrous periosteum: no synovial membrane or fluid existed. The next step of the operation consisted in drilling the extremities of the bone, which having been done with a common gimlet, a piece of wire was introduced, to maintain them in apposition. The ends of the wire were twisted together, and allowed to protrude from the wound, the edges of which were brought together by three sutures and adhesive strips. Two splints and a roller being applied, the arm was firmly supported in a sling. There was very little hemorrhage, and no vessel required ligation. As the patient suffered a great deal of pain, a grain of morphia was given immediately after the operation. Very little constitutional disturbance followed. Nearly all the wound healed by the first intention, and at no time was there much swelling, discoloration or suppuration. At the end of the eighth week, the process of reunion had advanced so far that there was scarcely any perceptible motion.

In a fortnight after this, the wire being removed, the patient went home perfectly restored, the arm being about an inch and a half shorter than the sound one. It is proper to add, that, by frequent passive motion, the elbow-joint was gradually regaining its original function.

In another case, that of a man, aged thirty-two, I treated with equal success, by an operation of this kind, an ununited fracture of the humerus of twenty-seven months' standing. The ends of the fragments were connected by two silver wires, which were permanently retained. The case is reported at length in the North American Medico-Chirurgical Review for July, 1861.

The results of some of the above operations have been placed in a striking and interesting light by the statistics of Dr. Norris. Thus, in forty-six cases in which the seton was used, thirty-six were cured, three died, three were partially relieved, and five experienced no benefit. Of thirty-eight cases of resection, twenty-four were cured, six died, one was partially cured, and seven received no benefit. Of eight treated by cauterization of the ends of the fragments, six were cured. Of eleven cases in which friction was employed all were cured. It is worthy of remark that the treatment by the seton is less successful in fracture of the femur and humerus, than in that of any other bones. The danger of the more severe operations, especially the seton and resection, follows the same laws as in amputation, increasing with the size of the limb and its proximity to the trunk.

Fig. 343.



Smith's apparatus for ununited fracture.

Whatever plan of treatment be adopted, it is impossible to be too attentive in the after-management of the case, especially in securing repose and accuracy of apposition to the ends of the fragments. The limb should be promptly put up in appropriate splints, which should be taken off from time to time, and carefully readjusted, just as in the treatment of a recent fracture. If the affected bone be one of the lower extremity, as the femur or tibia, it will be well to let the patient walk about in the open air upon crutches, particularly if he have experienced much constitutional change, the limb being supported by the admirable contrivance of Professor Smith, of the University of Pennsylvania. The apparatus, as seen in fig. 343, is constructed upon the same principles as the ordinary club-foot apparatus, consisting of a shoe, and of a leg and a thigh-piece, connected by hinges, and fastened round the limb by straps and buckles.

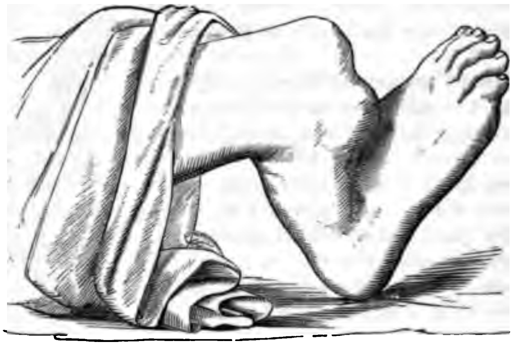
If any of the more severe operations are performed, the treatment, for the first few days, must be strictly antiphlogistic, the patient being most carefully watched, lest the inflammation, running too high, may induce fatal consequences. If abscesses form, they should be promptly opened, and the greatest attention should, throughout, be bestowed upon cleanliness. The great danger to be apprehended after such operations is from erysipelas, pyemia, and phlebitis.

When all the known remedies, after a thorough trial, fail, and the limb is utterly useless, the only resource is amputation. Few cases, however, demanding such a terrible alternative, will be likely to arise in the present state of the science.

7. VICIOUS UNION OF FRACTURES.

In consequence of inattention of the surgeon, or a want of co-operation on the part of the patient, the ends of a broken bone sometimes unite in a very unseemly and injurious manner, entirely at variance with the beauty and usefulness of the affected limb, as represented in fig. 344. The deformity thus arising may be produced by the overlapping of the extremities of the fragments, attended, of course, with corresponding shortening; or it may be owing to the imperfect contact of the two ends, thus occasioning a certain amount of angular displacement, without any abbreviation of the length of the bone. In whatever way the deformity may be induced, it is obvious that it should be rectified at the earliest possible moment; for the longer the case is permitted to remain on hand, the more difficult it will be to afford relief. There are several procedures by which this object may be attained: 1st. Compression and extension; 2d, forcible flexion, or rupture of the callus; and 3dly, resection of the ends of the fragments. These methods are not, of course, all equally applicable in all cases.

Fig. 344.



Viciously united fracture of the leg.

1st. The safest as well as the most simple procedure, but one which is applicable only in the more early stages of vicious union, consists in applying pressure opposite to the seat of the deformity, in the direction of its convexity. This may be efficiently done by means of appropriate splints and bandages, or with an apparatus specially constructed for the purpose, provided with pads and screws, and appliances for making extension and counter-extension, particularly if there be marked shortening. It is not necessary to give any descriptions of these contrivances, as they may be readily fabricated by any ingenious mechanic, or even by the surgeon himself. No preliminary treatment will be required. It is nonsense to suppose that we can soften the callus by cataplasms and fomentations in such cases. The compression and extension should be made, at first, in as gentle a manner as possible, and be gradually increased and steadily maintained up to the point of easy tolerance, being occasionally intermitted if productive of pain, or likely to induce excoriation.

2dly. If the preceding method fail, or is inapplicable, recourse may be had to forcible extension, or rupture of the callus, thus compelling the displaced fragments to retrace their steps. This plan also is chiefly applicable to recent cases, but occasionally it has been employed at the end of six, eight, ten, or even twelve weeks. I have myself successfully employed it at the expiration of the second month, and repeatedly within the first three weeks. It would be difficult to say when it should be refrained from; much will necessarily depend upon circumstances, for in one case the union may be firm in a month, while in another, perhaps equally simple, if not more so, twice or thrice that period may elapse before it becomes consolidated. Perhaps as good a guide as any would be the existence of slight mobility between the ends of the fragments; if the union is very strong, the attempt to break it might be attended with fracture of the bone above or below the seat of the callus, and so complicate the case. Besides, the operation, except in the more simple forms of the affection, should not be undertaken without some preparation of the system, as it is occasionally followed by violent inflammation, erysipelas, abscess, and even death.

The operation is easily performed, before the union has become consolidated, simply by bending the limb over the knee, the patient being completely narcotized by chloroform, or by placing it upon a table, and applying pressure upon the distal extremities of the fragments. When the case is of long standing, and the union firm, the callus can only be broken by the employment of force applied by some special apparatus, designed either to act directly upon the callus, or by means of a weight appended to the distal extremity of the bone, the fractured part projecting slightly over the edge of the table, while the portion of the limb containing the upper fragment is carefully held down by assistants. It has been ascertained by experiments, performed by Jacquemin, Bosch, Œsterlen, and others, that the callus of a thigh-bone, broken fifty days previously, will require a weight of from fifty to sixty pounds to sever the fragments at the seat of the callus.

3dly. When the union is complete, and the preceding methods have either failed or are inapplicable, trial may be made of the plan of Dr. Brainard, consisting in the partial division of the bone, the object being to weaken it in such a manner as to admit of its more ready fracture, or gradual bending by systematic compression, as the new osseous matter becomes softened from the effects of the inflammation consequent upon the operation. The perforation is effected subcutaneously by means of a drill, the point of which is about one-fourth of an inch in breadth. If it is intended to break the bone, this should be done at once, and the limb immediately placed in a suitable apparatus. If, on the other hand, the rectification is to be effected by bending, no formal measures, for this purpose, should be adopted for the first eight or ten days, or until the osseous tissues have undergone a certain amount of softening. Several cases, including one by Dr. Brainard himself, have been successfully treated by this plan since he first directed attention to it in January, 1859.

4thly. Other means failing, the only resource that remains is *excision* of a portion of bone at the seat of the fracture, along with a portion of the callus. With this procedure, the origin of which dates back to the early part of the sixteenth century, and which was revived in the early part of this, are associated the names of a number of distinguished surgeons, both in Europe and in the United States; in the latter, those of Parry, Stevens, Mütter, Barton, and Pancoast, nearly all of whom have performed the operation successfully. The operation consists in exposing the extremities of the broken bone, and removing, with the saw or pliers, a sufficient piece to admit of accurate coaptation of the raw surfaces. The case is afterwards treated as one of ordinary compound fracture.

Finally, when relief is impracticable by any of the means now described, and the limb is sadly in the way of comfort and usefulness, the individual being perhaps obliged to labor for his daily subsistence, the only alternative is either to abandon him to his fate or to resort to amputation.

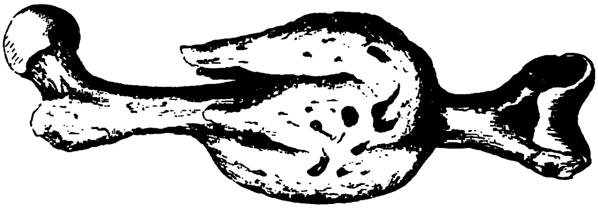
In 1851, I met with an instance of compound fracture of the tibia, in a young man of nineteen, in whom about two inches of that bone, near its middle, had been shot away, two years previously, by a rifle ball. The fibula had remained intact, and with the aid of a stiff leather splint, forming a case which reached from just below the knee to within a short distance of the ankle, progression was performed with tolerable ease, though not without the use of a crutch. If the deficiency of bone had been somewhat less, I should have been tempted to cut away a portion of the fibula, and, after refreshing the end of the tibia, to approximate the bones by silver wire; fully anticipating a good cure.

8. DISEASES OF THE CALLUS.

The callus, like all new tissues, is liable to different diseases, both during its development and after its completion, more or less hostile to its welfare and perpetuity. Some of these affections have a local origin, some depend upon the state of the constitution, and others, again, seem to partake of the nature of both of these. Deficiency of the callus, although not, properly speaking, a disease, may, nevertheless, become a source of great difficulty on account of its inability to subserve the purpose of a supporting medium. The causes which may induce this condition, and the means of remedying it, when it exists, have already been pointed out.

An exuberant callus is by no means uncommon; it occasionally arises without any obvious cause, but more generally it is dependent upon the separation of the ends of the broken bone, as if nature were determined to effect union, despite of the neglect of the surgeon. The annexed cut, fig. 345, from a drawing of a specimen in the possession of the late Professor Cobb, of the University of Louisville, affords a graphic illustration of an excess of this substance, obviously produced in this way. It is one of the most remarkable preparations of the kind that I have seen. The fracture, which was oblique, and situated just above the middle of the right femur, had evidently occurred several years before death. The callus, exceedingly porous in its structure, and very brittle, is eleven inches in circumference at the widest part, by six inches in length. From its superior extremity are detached two processes, which overlap the upper fragment, and must have materially impeded the action of the muscles of the limb.

Fig. 345.



Exuberant callus after fracture of the thigh.

Exuberance of the callus is occasionally produced by the presence of pieces of dead bone, which it thus incloses as foreign bodies are sometimes inclosed by a cyst, or a wall of plastic matter. The sheath thus formed, however, is always imperfect, openings existing in it in different parts of its extent for the purposes, apparently, of drainage. Neglected or badly-treated comminuted fractures, caused by gunshot, railway, and other severe injury, are not unfrequently followed by an extraordinary redundancy of callus; and as the effect of this substance is to incarcerate the fragments of the broken bone, profuse discharge, generally of an unhealthy, fetid, and sanious character, may be thus kept up for almost an indefinite period. The proper remedy obviously is the extraction of the dead fragment, a procedure occasionally of a very embarrassing character, especially when the callus is situated in a bone thickly covered by muscles, or in close proximity with important vessels and nerves. In the case of Lieut. Adams, of the United States Marine Corps, I removed not less than twenty-four pieces of this kind, some of them of considerable size, having previously made a long incision over the tumor in front of the thigh. With the aid of chisels, gouges and pliers, riddance was effected with but little loss of blood, and with no pain, as the patient was thoroughly under the influence of chloroform. Although the number of dead pieces was unusually great, yet such was the size and firmness of the callus that, notwithstanding it was obliged to be divided in almost every direction, no separation of the ends of the broken bone ensued, and the patient, after having recovered from the immediate effects of the operation, was able to walk about as before. It is proper to add that the fracture had occurred nine months previously from a blow by an escapette ball.

The callus is subject to extraordinary *brittleness*, arising from an excess of earthy matter. Such an event may occur at a comparatively early period, as a result of causes whose true nature is not always easy of detection. I believe, however, that fragility of the callus is more frequently met with in persons of a gouty, rheumatic, and syphilitic state of the system, than in any other class of individuals. However induced, the slightest injury, as a mere twist of the bone, or even muscular exertion, is generally capable of fracturing it, and, consequently, of re-separating the ends of the fragments.

Finally, callus is subject to *softening*, disintegration, and absorption, if not, also, to the fatty degeneration. The causes under whose influence these changes are effected are not always, or, perhaps, even generally, distinguishable. In some cases they are plainly due to undue compression, as from tight bandaging; in others, they are induced by premature exercise. Occasionally, the absorption can be distinctly traced to the inordinate use of mercury, carried to profuse salivation; or it may be owing to a syphilitic taint of the system, especially when this affection has reached its third stage, in which the bones and periosteum are so constantly, and often so seriously involved. But the most common cause, perhaps, of all, is an impoverished and diseased state of the blood, from the use of improper food, and especially from the want of a sufficient quantity of fresh vegetables and subacid fruits. The influence of ill health arising from this cause upon the condition of the callus, was strikingly exemplified in Lord Anson's voyage to the Pacific Ocean, in which many of the crew suffered severely from scurvy. It was noticed that those who had formerly had fractures were attacked with absorption of the callus, speedily terminating in disunion of the ends of the broken bone. Cicatrices, whether the result of the healing of wounds or of ulcers, experienced a similar fate, the parts breaking out into open sores, remarkably pale, languid, flabby, and difficult of cure. Similar effects are occasionally observed to follow attacks of typhoid fever and anemic states of the system, however engendered.

The treatment of softening and breaking down of the callus must depend upon the nature of the exciting cause, due inquiry into which should, therefore, always be made as a preliminary step. Tight bandages and splints are removed; premature exercise is avoided; iodide of potassium and mercury are administered if the cause is obviously of a syphilitic nature; scurvy is relieved by a change of diet, especially the use of subacid fruits and vegetables; and anemia is met with tonics and stimulants, as iron and quinine, with milk punch and nutritious food.

SECT. XVI.—FRACTURES OF PARTICULAR BONES.

1. HEAD AND TRUNK.

FRACTURES OF THE NASAL BONES.

Falls and blows are the causes of this fracture, which may be either simple or complicated; oblique, transverse, or longitudinal; limited to one bone or extended over both. It is usually attended with severe injury of the soft parts, and sometimes with fracture of the ascending process of the superior maxillary bone. Occasionally, again, but more rarely, there is a separation of the nasal cartilages, or fracture of the ethmoid bone, the vomer, or turbinated bone. The symptoms are generally well marked, except when there is considerable swelling of the integuments, in which case the nature of the lesion may easily be overlooked, perhaps much to the detriment of the patient. If an examination be made soon after the occurrence of the accident, the nose will be found to be out of shape, from displacement of the fragments, one of which may be depressed towards the nostril, while the other may form an unusual prominence beneath the skin. Crepitation is also commonly distinguishable, especially if the fracture be multiple, or the bone broken into several pieces. In all cases, the point of the finger should be passed over the surface of the nose, with a view of ascertaining whether there be any irregularity or mobility, as there will be almost sure to be if there is a fracture. If, after this, there be still some doubt, it will be well to introduce a large probe, metallic bougie, or grooved director into the nostril, for the purpose of making counter-pressure, while pressure is applied in the opposite direction with the end of the finger. When there is a wound, denuding the bone, the diagnosis will seldom be difficult.

More or less *bleeding* generally attends this accident; occasionally, indeed, it is quite profuse, and in one instance it is said to have proved fatal. Another symptom which is sometimes present, is emphysema at the root of the nose, extending along the eyebrows. It usually comes on within a short time after the accident, and is owing to an escape of air from the nostril across a rent of the mucous membrane into the subcutaneous cellular tissue. It is in itself of no moment, as it usually disappears spontaneously in a few days. Sometimes violent head symptoms attend these fractures, depending upon the intimate connection between the nasal and frontal bones, which permits the jarring effects of the blow or fall to be communicated to the brain and its envelops.

Fracture of the nasal bones is not always free from *danger*, although, in general, it is so, the patient recovering without any untoward symptoms. Real danger to life is to be apprehended only when there is serious cerebral involvement, as when the lesion is associated with fracture of the cribriform plate of the ethmoid bone, separation of the dura mater at the anterior part of the base of the skull, copious effusion of blood, or severe concussion of the brain. Under such circumstances, the patient may die from shock, from compression, or from inflammation. The prognosis should, therefore, be guarded, especially as the degree of danger cannot always be estimated by the amount of visible injury. If the fracture is multiple, or the bones are crushed in, more or less deformity may be expected after the cure.

The *reduction* is generally easy. The patient being seated upon a chair, with his head resting against the breast of an assistant, any depression that may exist is to be remedied by means of a female catheter or grooved director, inserted into the nostril, and made to bear against the displaced fragment until it has resumed its proper level. Sometimes a good deal of pressure and counter-pressure will be necessary, while at other times hardly any manipulation whatever will be required, the mere passage of the finger over the seat of the fracture being sufficient to adjust the fragments. When the nasal septum, or the perpendicular plate of the ethmoid, is thrown out of place, restoration may be effected by means of the finger, or some suitable instrument, introduced into the nostril.

When the fragments have been restored to their natural level, they will usually retain their position with little or no difficulty. Sometimes, however, they have a tendency to cave in, or to fall asunder, in spite of everything that can be done to counteract it. The best remedy is a stout, adhesive strip, carried across the bridge of the nose from one cheek to the other; the plaster promptly adheres to the skin, and assuming the shape of the nose, effectually prevents further displacement. The older surgeons were in the habit of counteracting this occurrence by stuffing the nostrils with dossils of lint, smeared with ointment, and frequently changed for the sake of cleanliness. Subsequently, metallic tubes were recommended, and in modern times tubes of gum elastic have been used. All such contrivances are now very properly dispensed with; or, if they are ever employed, it is in cases where it is impossible, in consequence of the manner in which the bones have been crushed, to remedy the displacement in any other way.

The symptoms which usually follow this accident, such as inflammation of the pituitary membrane, and swelling of the nose and face, are combated by general and local bleeding, purgatives, and other antiphlogistics. The brain is carefully watched, and any untoward symptom met at the earliest possible moment. Hemorrhage is restrained by cold applications, and elevation of the head and arms; if obstinate, by plugging up the nostrils.

Nasal Cartilages.—The nasal cartilages are sometimes broken, or broken and partially detached from the nasal and maxillary bones, the most common cause of the accident being a violent blow or fall, inflicting perhaps at the same time serious injury upon the soft parts. The nature of the case can seldom be mistaken. When the cartilages are displaced inwards the nose will necessarily be more or less flattened and depressed, and the effects will assume increased importance if the lesion be conjoined with fracture of the nasal bones and the cartilaginous septum. The treatment must be conducted upon general principles. The great aim should be to preserve the contour of the nose; and hence, after having restored the parts to their proper relations, it may be necessary to plug the nostrils with lint, well oiled, a metallic tube having previously been inserted to facilitate respiration. Leeches may be required to moderate inflammation.

In the case of a man, aged forty, brought to the Jefferson College Clinic last September by Dr. McWhinney, the septum, broken into several pieces four months previously, encroached so much upon the left nostril as to cause almost complete obstruction to respiration on that side. In order to afford relief I was compelled to cut away the whole of the offending part with a probe-pointed bistoury. The nose seemed to have been very little deformed by the accident.

FRACTURES OF THE UPPER JAW.

A fracture of the upper jaw implies the application of direct mechanical injury, in a concentrated and severe form. No ordinary force could produce such a result. In a few instances it has been caused by contre-coup, the head and lower jaw being wedged in between two hard, resisting bodies. Portions of the alveolar process, of variable shape, and even of large size, are sometimes broken off in the operation of extracting teeth. There is nothing definite at all in regard to the situation of the fracture, since it may affect any portion of the bone, its body, ascending process, horizontal plate, or alveolar process. It is always accompanied by severe injury of the soft and hard parts, and is usually of easy recognition, simple inspection, or touch, commonly sufficing for the purpose. The accident is apt to be followed by violent inflammation, requiring prompt measures for its relief.

In the *reduction*, pressure and counter-pressure are chiefly relied upon, the parts being moulded gently into their natural position by the fingers, either alone, or aided, as in fracture of the horizontal plate of the bone, by the grooved director inserted in the nostril. If the alveolar process has suffered, it may become necessary to secure its proper maintenance by tying together several of the contiguous teeth by thin silver wire. Whatever may be the nature of the case, the rule is, if possible, to save all, and take away nothing.

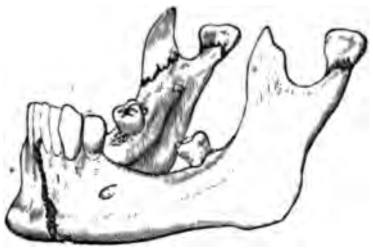
FRACTURES OF THE MALAR BONE.

Fracture of the malar bone is so very rare as to require merely a passing notice. Like fracture of the upper jaw, it is always produced by direct violence, is invariably attended with severe contusion, if not with other injury, of the soft parts, is, in general, readily recognized, is liable to be followed by high inflammation, and is easy or difficult of management according as there is displacement or no displacement. When the broken part has sunk down beyond its natural level, an attempt may be made to raise it, especially if there be already a wound denuding the bone, and admitting of the insertion of a suitable lever; if not, an incision is made, provided it seem probable that there will be unsightly deformity after the cure is effected, if the fragment be left in its abnormal situation. Such a procedure, although condemned by some high authorities, is much better, it appears to me, than to leave the bone where it was thrown by the accident. Fracture of the zygomatic process of the temporal bone, also exceedingly rare, is treated upon similar principles to that just described.

FRACTURES OF THE LOWER JAW.

The lower jaw-bone may be broken in any portion of its extent, not excepting even the symphysis. Fracture here, however, is uncommon, and is met with chiefly in young subjects, before the complete union of the two opposite halves of the bone. The most common site of fracture is the body of the maxilla, towards its anterior extremity, as seen in fig. 346; and next in point of frequency, at least according to my observation, is its ascending ramus. The condyle, neck, and coronoid process are seldom broken. The fracture may be transverse, oblique, or longitudinal; single or multiple; simple or complicated. When the bone yields at two points, there will necessarily be three fragments; cases occur in which the number is still greater, the bone being literally crushed. Houzelot has published the particulars of one in which the bone was broken at both condyles, through both coronoid processes, and at the symphysis, the accident having happened by a fall from a height. Sometimes the lesion is limited to the alveolar process, or this process gives way along with the body of the jaw. In either event, there will be involvement of the gums and teeth, with, perhaps, extensive separation of the latter, or even complete evulsion. Occasionally a longitudinal fracture of the body of the bone is intersected at each extremity by a transverse or oblique one. The accident, which rarely occurs before the age of manhood, is much more frequent in males than in females.

Fig. 346.



Fracture of the jaw.

The most common *cause* of fracture of the inferior jaw is direct violence, as a fall, blow, or kick. I have seen not less than four instances where it was produced by a blow with the fist upon the chin or side of the bone, one of the cases being a healthy lad between fifteen and sixteen years of age; the others, persons between twenty-five and thirty-two. A very common cause of this fracture is the kick of a horse. Dentists often break off portions of the alveolar process in their efforts to extract teeth. Sometimes frightful injury is produced in this way. Muscular action is capable of breaking the lower jaw. An old man, aged upwards of seventy, an out-patient of the Jefferson College Clinic, presented himself to Professor Pancoast in January, 1857, on account of a fracture of the neck of this bone, caused the night before in a violent paroxysm of coughing. The symptoms were unmistakable. The explosion of powder in firing off a pistol within the mouth has also been known to give rise to the accident. Finally, the jaw-bone is sometimes broken on one side by a blow upon the opposite, or by counter-stroke.

The *symptoms* denotive of fracture of the body of the lower jaw are generally so well defined as to render it easy to form a correct diagnosis. Crepitation can almost always be observed in moving the fragments, and upon looking into the mouth the teeth will usually be found to have lost their natural relations. There is also commonly a perceptible inequality at the inferior border of the bone, which may always be increased by motion, and which is of itself sufficient to point out the character of the injury. When the jaw has given way on each side, the central piece will be drawn downwards by the action of the muscles of the throat, the front teeth will be out of their normal position, and the mouth will be open and distorted.

When the *ramus* of the jaw is broken, there will be a grating noise at the site of fracture, and excessive pain near the ear. From the fact that the masseter muscle is attached to and covers in both fragments, it is seldom, if ever, that there is any considerable displacement.

A fracture of the *neck* of the bone is easily detected, unless the subject is very fat, by the crepitation produced on moving the jaw, by the preternatural mobility in front of the ear, and by the manner in which the body of the bone is dragged forward by the action of the external pterygoid muscle. Similar symptoms will characterize fracture of the condyle of the bone.

In addition to the symptoms now described as characterizing fracture of different portions of the inferior maxilla, there will be more or less impediment in speaking and swallowing, difficulty in closing the mouth, and inability to masticate. The patient experiences severe pain at the seat of fracture, which is aggravated by motion and manipulation. The soft parts are usually considerably contused, if not also lacerated, and there is often smart hemorrhage, either from wound of the mucous membrane or rupture of the inferior dental artery.

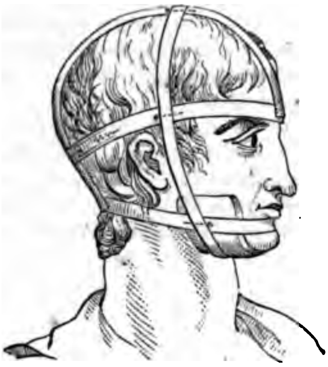
Simple fractures of this bone usually get well in from four to five weeks, without any deformity or functional impediment. Those of the neck require a longer time, and more care in their management, than those of the body and ramus. Complicated fractures, on the contrary, are often followed by severe suffering, caused either directly by the resulting inflammation, or by some of its more serious consequences, as abscess, caries, and necrosis. I have known, more than once, a patient to become much emaciated from his inability to take appropriate nourishment during the long confinement of his jaw.

During the *reduction* of fractures of this bone, the patient should be seated upon a chair, his head being supported upon the breast of an assistant, and firmly held. The surgeon, passing his fingers along the base of the jaw, supposing that it is the body that is broken, moulds the parts into a proper shape, and then, closing the mouth, sees that the lower teeth rest fairly against the upper. When the fragments overlap each other, they must be drawn in opposite directions, when the slightest pressure will generally suffice to effect their reduction. If any of the teeth are loosened, or partially forced from their sockets, and they are perfectly sound in other respects, they should by all means be retained, being secured, if need be, to the adjacent ones, by a strong ligature, or a thin silver wire. It was formerly the custom to treat such teeth as extraneous bodies, it being believed that they were incapable of re-adhesion; but more enlarged observation has shown the fallacy of this opinion, and the practice would, therefore, be highly reprehensible.

The fracture being reduced, as may always be known by the evenness of the dental arch and of the inferior margin of the jaw, a piece of pasteboard, or, what is preferable, of felt, is wet with hot water, and accurately adapted to the base and sides of the jaw, so as to form a firm mould for it. This being lined with wadding, and covered with a light compress, long enough to extend from the angles of the jaw nearly to the chin, is now confined by a roller carried round the top of the head in the form of the figure 8, one portion of the bandage lying in front of the ears, and the other behind them. The lower jaw being thus pressed firmly against the upper, the bandage is next conducted across the chin and the occiput above the ears, so as to give the fragments proper support in front. This mode of dressing, which is as simple as it is excellent, I have employed for many years, and give it a decided preference over every other of which I have any knowledge. If there be any unusual tendency to anterior displacement, it may be effectually counteracted by a stout adhesive strip, extending from the chin along the lower part of the face to the side of the occiput.

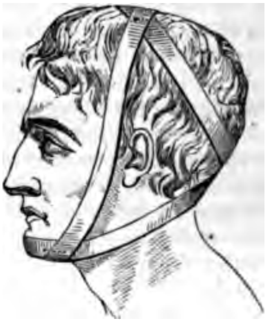
The annexed cuts, figs. 347, 348, represent the bandages of Gibson and Barton, so much employed in this country. Their mode of application will readily be perceived by an examination of the drawings.

Fig. 347.



Gibson's jaw bandage.

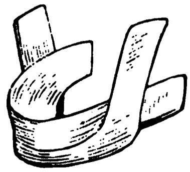
Fig. 348.



Barton's jaw bandage.

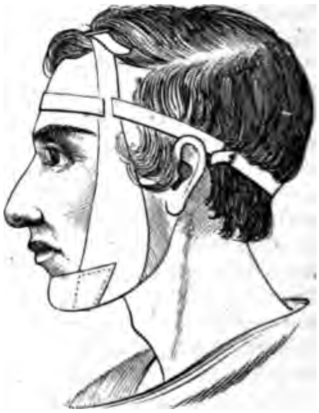
When there is no displacement of the fracture, as sometimes, though rarely, happens, an equally simple, but less efficient, contrivance will answer the purpose, as a pasteboard mould, fig. 349, and a four-tailed bandage. The centre of the bandage being applied to the chin, the posterior tails are pinned to the front, and the anterior to the back of the patient's nightcap. I had recently under my charge a case of fracture of this bone, unattended with displacement, where a rapid and perfect cure was effected without any dressing at all.

Fig. 349.



Pasteboard compress.

Fig. 350.



Hamilton's apparatus.

Professor Hamilton, in the treatment of fracture of this bone, employs an apparatus consisting of three straps, one of which, composed of firm leather, extends around the jaw and head in the direction of the coronal suture, while the other two, made of strong linen webbing, pass horizontally around the head, above the ear, the anterior being buckled to the forepart, and the posterior to the backpart of the vertical one. The great advantage of this contrivance, which is represented in fig. 350, is the strong support it gives to the parts, thus effectually preventing displacement of the ends of the fragments.

It was formerly customary, in bandaging fractures of the lower jaw, to fill up any irregularities that might exist between the two rows of teeth by the interposition of pieces of cork; but the practice, if I mistake not, is no longer pursued by the scientific surgeon; and yet it is easy to conceive of a case where, in consequence of the loss of all the incisor, cuspid, and bicuspid teeth, and the retention of some of the molar, some artificial support might become necessary for the proper maintenance of the fragments. In such a case the services of a skilful dentist should be called into requisition.

In fracture of the neck or condyle of the jaw, the maintenance of the reduction is always peculiarly difficult, on account of the action of the external pterygoid muscle. The most effective means of counteracting this disposition is to confine a thick, graduated compress behind the angle of the bone, the treatment being in other respects the same as in fracture of the body of the jaw.

When the fracture is comminuted, it will sometimes be found exceedingly difficult, if not impossible, despite our best directed efforts, to keep the fragments on a level with each other, such being their constant tendency to displacement. To rectify this tendency, it may be necessary to connect the contiguous teeth of the adjoining pieces with delicate silver wire; or, what is better, because more efficient, some of the teeth may be secured to a thin silver plate, interposed between them and the cheeks.

Wounds, contusions, and hemorrhage, complicating these fractures, are managed upon general principles; inflammation is combated by the usual antiphlogistics; loosened teeth and necrosed pieces of bone are removed as soon as they are detached; and the parts are kept steadily at rest, renewal of displacement being guarded against by the most sedulous attention both of the patient and the surgeon. The food should consist of slops, as grated cracker and milk, broths, gruel, and similar articles, and should be introduced into the mouth with a small spoon. The custom which formerly prevailed of conveying nourishment into the stomach by means of a tube carried along the nose, has become obsolete, as well as the still more reprehensible practice of extracting one of the front teeth, to afford room for feeding the patient. After the case has advanced for several weeks, a semi-solid, farinaceous diet may be allowed.

FRACTURES OF THE HYOID BONE.

Fracture of the hyoid bone is extremely rare. The cause of this immunity is to be found in the great mobility of this bone, and in the protection which it receives from the lower jaw. The accident is usually occasioned by falls or blows, or by the pressure of the thumb and fingers in attempts at choking. An instance is mentioned where it was produced by muscular action, the patient having fallen violently backwards upon his head. Persons who commit suicide by hanging occasionally break this bone with the rope. The fracture is generally seated in the large horns of the bone, sometimes in both, at other times only in one. It is liable to be complicated with injury of the larynx, lower jaw, and other parts, the skin being usually bruised and discolored. The patient is unable to swallow, to articulate distinctly, and to move his tongue, except in the most limited degree, and then not without great suffering, and, perhaps, a sense of suffocation. Crepitation is generally sufficiently evident, especially during deglutition and when the index finger is placed in the throat in contact with the smaller fragments, the corresponding finger resting upon the neck. The pain is very acute, and is aggravated by the slightest motion. Sometimes the patient is conscious of a peculiar crushing sound at the moment of the accident. Occasionally there is laceration of the mucous membrane of the fauces, followed by pretty copious hemorrhage, as in the interesting case reported by Professor Wood, of Cincinnati.

Fracture of the hyoid bone, although not in itself necessarily dangerous to life, often becomes so in consequence of its complications; but, even in the most simple cases, it is generally exceedingly troublesome on account of the great mobility of the fragments, and the tendency in the supervening inflammation to be followed by severe swelling. Occasionally abscesses form, the detached piece becomes necrosed, and the neck is pierced with fistulous orifices, which are slow in healing. The accident has hitherto been noticed chiefly in aged subjects, probably on account of the great brittleness of the bone at this period of life.

In the *treatment* of this fracture, attention must be paid to the position of the head, which should be inclined forward, and maintained in a state of the utmost quietude, by an appropriate bandage secured around the chest. If there be much displacement, readjustment should be attempted by means of the finger in the throat while counter-pressure is made externally. Perfect silence should be enjoined. If there be much pain and swelling, leeches should be applied to the neck, followed by saturnine and anodyne fomentations; the bowels should be freely evacuated by stimulating injections, and fever should be combated, if necessary, by bleeding at the arm. For the first few days, the patient should abstain as much as possible from food and drink; at all events, he should take no more than what is just sufficient to sustain life. If he cannot swallow, a stomach tube must be used, but, in general, this will not be necessary. After the swelling of the neck has measurably subsided, an attempt should be made to keep the fragments in place by a compress and adhesive strips, though little, it must be confessed, is to be expected from such a course. If any portion of the bone becomes necrosed, an early opportunity is sought to extract it. In ordinary cases, the fracture will unite in from six to eight weeks.

FRACTURES OF THE LARYNX.

The cartilages of the larynx may be broken by external violence, as a blow, the kick of a horse, or the pressure of the thumb and fingers. The accident is most liable to happen in elderly subjects, after the partial ossification of these bodies, and the one which is most apt to suffer is the thyroid. The fracture may be simple, comminuted, or complicated. The only reliable diagnostic symptoms are crepitation, displacement of the fragments, and preternatural mobility. The common accompaniments are difficulty of articulation, breathing, and deglutition, loss of voice, cough, hemorrhage, and probably also emphysema, from an escape of air into the surrounding cellular tissue.

Most of the cases of this accident prove fatal, either soon after its occurrence from suffocation, or more or less remotely from the effects of inflammation.

Fractures of the laryngeal cartilages, unless attended with serious displacement, require little else than the ordinary antiphlogistic measures, with perfect quietude of the head and neck. When there is extensive separation of the fragments, interfering with respiration, laryngotomy may be required, both to afford an opportunity to readjust the broken pieces, and to prevent death by suffocation.

FRACTURES OF THE CLAVICLE.

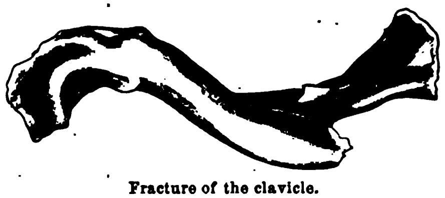
The clavicle, owing to the delicacy of its structure, its exposed situation at the top of the chest, and its connection with the shoulder and arm, is extremely liable to break. Of 2358 cases of fractures of different pieces of the skeleton, referred to by Malgaigne, 228 occurred in this bone, and of this number nearly three-fourths were observed in the male, thus showing a remarkable disparity in regard to the relative frequency of the lesion in the two sexes. The accident is not peculiar to any particular period of life; I have witnessed it in a child under six months of age; and Dr. W. Keller, of this city, showed me a case last winter in which it took place in the fœtus in the womb, in consequence of a fall of the mother upon the wheel of a carriage, at the eighteenth week of gestation. The child, at the time of my examination, was several months old, and the seat of the fracture, which had involved the right clavicle, near its middle, was indicated by a marked forward angular projection of the ends of the fragments, which, however, were firmly united, the consolidation having been completed before birth. A similar case was lately shown me by Dr. William B. Atkinson, the fracture having been produced by a blow from a door upon the abdomen when the mother was gone seven months in pregnancy.

Fractures of this bone may be simple, compound, or comminuted; unilateral or bilateral; transverse or oblique; partial or complete. A transverse fracture of the clavicle is among the rarest of accidents; as for myself, I have never met with an instance of it, either in the living subject, or in any of the specimens in our museums. The bone nearly always gives way obliquely, the ends of the fragments being generally rather long and sharp, and often distinctly serrated. When very sharp, they sometimes project through the skin, or, at all events, press against it with so much force as to cause severe uneasiness, and great difficulty in maintaining apposition. It is very uncommon for the bone to break at several points; such an accident, in fact, can only happen from the application of direct force. Simultaneous fracture of both clavicles has been observed only in a few instances. I have two clavicles in my possession, from the same subject, which were both broken at the same point, but whether at the same time, I am unable to say.

The *seat* of fracture is usually at or near the middle of the bone, where it is thinnest and weakest. Of twelve preparations now before me, it is in eight about this point; in three it is towards the acromial extremity, and in one towards the sternal. Fracture of either end is, I suppose, very uncommon, as I have never met with an instance, either during life or after death.

Great *displacement* generally attends fractures of the clavicle, as shown in fig. 351; now and then, however, we see cases where the broken ends maintain their natural relations, as I have myself noticed in two instances. Such an event can only occur when the fracture is incomplete, as sometimes hap-

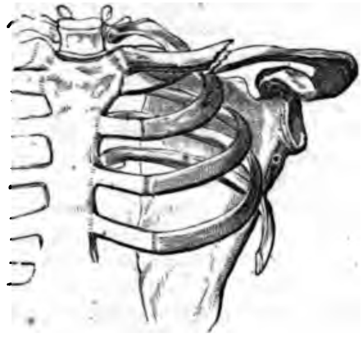
Fig. 351.



Fracture of the clavicle.

pens in children, or when the periosteum is only partially divided, and the patient has taken care not to permit any dragging of the shoulder. As a general rule, the outer fragment will be found to be drawn downwards, forwards, and inwards, by the weight of the limb and by the action of the deltoid, small pectoral, and subclavian muscles; the inner, on the contrary, is usually somewhat raised by the sterno-cleido-mastoid, but not nearly as much so as its extraordinary prominence would seem to indicate, its tendency to displacement in that direction being pretty effectually counteracted by the great pectoral muscle and the costo-clavicular ligament. These appearances are well seen in fig. 352. In fracture of the extremities of the clavicle, the loss of apposition is usually very slight, its occurrence being prevented by the manner in which the bone is attached to the scapula and the sternum. In comminuted fracture, the displacement is sometimes so great as to render reposition impracticable, the middle fragment being occasionally tilted perpendicularly up.

Fig. 352.



Complete oblique fracture, near the middle of the clavicle.

The accident is generally *caused* by indirect violence, as a fall upon the shoulder, in which the sternal extremity of the bone is impelled by the weight of the body, at the same time that the acromial end is thrust forcibly in the opposite direction by the object struck against. Not unfrequently, however, it occurs from direct injury, as a blow or fall. In one instance I knew it to be produced by the kick of a gun, in shooting at a flock of pigeons. Children often break their collar bones by tumbling out of bed, or rolling down a flight of stairs. When both clavicles are broken, one generally gives way by indirect, and the other, immediately after, by direct force.

The *symptoms* of fracture of the clavicle are generally well marked. The shoulder has a singularly sunken appearance, being drawn downwards, forwards, and inwards by the weight of the limb and the action of the muscles, especially the deltoid and small pectoral; the head and trunk are inclined towards the injured side; there is impossibility of rotating the arm, or of carrying the hand to the face; and the patient commonly supports the elbow in order to take off the weight of the limb from the broken bone. Upon examination, the seat of the fracture is generally readily discovered by the eye, the deformity being nearly always extremely conspicuous; and the finger, as it traces the outline of the bone, cannot fail to detect any existing irregularity. Crepitation is elicited by taking hold of the elbow and pushing the arm upwards, outwards, and backwards, in a direction opposite to that of the displacement. The same procedure will serve to efface the deformity, which, however, will be instantly reproduced upon the removal of the restraint. When the fracture is imperfect, or unattended with displacement, the diagnosis can only be established, as a general rule, by a careful digital examination, aided by the alternate elevation and depression of the shoulder.

Although, in general, the patient is unable, in fracture of the clavicle, to carry his hand to the head, yet I have met with some very striking exceptions to this rule, both in children and adults. In a man, aged forty, whom I saw a few years ago with Dr. Dennis O'Reilly, the patient could execute this movement with quite as much facility as with the other limb. He could even swing it about without any pain or inconvenience. The fracture, caused by a fall on the edge of a doorstep, was situated towards the acromial extremity of the bone, and was attended with marked displacement. Children, according to my observation, are more subject to this anomaly than grown persons.

My experience is that fractures of the clavicle are seldom cured without more or less deformity, whatever pains may be taken to accomplish the object. In some of my cases I have found it impossible, despite all the efforts I could command, to effect accurate restoration of the ends of the fragments. This difficulty will, I think, be most likely to occur when the fracture is seated at or towards the acromial extremity of the bone, in which event the outer fragment is frequently, if not generally, thrown backwards in such a manner as to render it almost impossible to bring it to its natural position. From the cases that I have seen of this fracture, as treated by other surgeons, and from the numerous specimens of it to be found in our museums, I am satisfied that a cure without deformity is a very uncommon result. It is gratifying, however, to know that deformity, even when considerable, does not, as a general rule, at all impair the usefulness of the limb. Union will, of course, be materially retarded, but in time nature will succeed in rounding off the ends of the fragments, and in connecting them firmly together, either by an osseous clasp or a kind of bridge. When union fails to occur, the power of the arm is always weakened. In ordinary cases, consolidation takes place, in the adult, in about five weeks, and in children, in eighteen or twenty days.

In the *reduction* of fracture of the clavicle, all that is generally necessary is, to take hold of the elbow and to carry the arm upwards, outwards, and backwards, a procedure which rarely fails to effect approximation of the ends of the fragments. If anything more is required, the fingers may be passed along the broken bone, so as to assist in moulding the parts into proper shape. During the treatment the indication is to maintain the shoulder in the position here adverted to; and for this purpose it will be necessary to support the limb in such a manner as to bring the elbow against the antero-lateral aspect of the chest, while the forearm rests against the front, the fingers lying across the opposite clavicle. To confine them in this position, the best dressing is a number of adhesive strips, of appropriate length, to reach around the limb and shoulders, so as to form, in the first place, a kind of immovable sling, and, secondly, to secure the arm to the side of the trunk. When this dressing, which is more easily applied than described, is carefully put on, it answers the object much better than any of the numerous contrivances that have ever been invented for the cure of this fracture. The strips, which should be from an inch and a half to two inches in width, may be so arranged as to make a certain degree of pressure, through the medium of a compress, directly upon the seat of the fracture, or, if this be deemed unnecessary, the seat of fracture may be kept under constant surveillance by letting it remain uncovered. The dressing, if properly applied, need not be renewed oftener than once or twice during the treatment, if, indeed, at all. If the patient be an adult, and the skin be covered with hair, the surface should be previously shaved. When there is a tendency on the part of the shoulder to sink forwards and inwards, it should be counteracted by a wedge-shaped pad in the axilla, the large extremity being directed upwards, and confined by suitable tapes to the opposite shoulder. In general, however, I have not found it necessary to resort to such an expedient.

Next to the adhesive strip dressing, which I have used and recommended for some years past, in the treatment of fractured clavicle, I prefer a very simple contrivance, somewhat after that of Velpeau. It consists of a wedge-shaped pad, and an ordinary roller, carried round the limb, shoulder, and trunk, so as to confine the parts in the position already indicated. The different turns of the bandage should be secured to each other by a large number of pins, which thus serve to keep them effectually in place. I seldom use less than from thirty to forty, and I find that, when this is done, the bandage

This book is the
COOPER MEDICAL CO

may be worn with great advantage for several successive weeks, without the slightest derangement. In warm weather, however, it should be removed at least as often as every ten days for the sake of cleanliness, especially if the patient perspire much.

An ingenious apparatus for the treatment of fracture of the clavicle has been devised by Dr. R. J. Levis, of this city, which, combining most of the principles of that of Dr. Fox, so long and so extensively used in this country, commends itself by its simplicity, lightness, efficiency, and cheapness. It consists of a short, firm, axillary pad, supported by two straps which are buckled to a broad supporting band. From the front of this band, which crosses the upper part of the back, and descends on the anterior portion of the chest, giving a firm surface of support, is suspended a sling in which the elbow is sustained. On the back of the sling, behind the elbow, is fastened a strap which crosses the back obliquely, and coming in front on the sound side, is buckled to the front end of the supporting band.

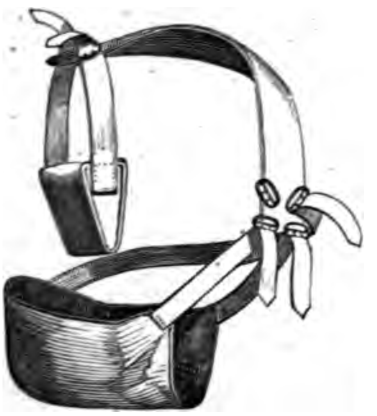
In adjusting the apparatus, the pad is first placed in the axilla by passing the arm through the opening between the straps above the pad. The wide band is then thrown across the shoulders, the elbow placed in the sling, and the long strap attached to the back of the sling carried across the back and finally buckled at its front attachment to the wide supporting band.

In removing the apparatus from the patient, it is only requisite to loosen the front attachment of the latter strap, which will allow the sling to drop from the elbow.

The extra buckle, which is noticed at the front end of the wide supporting band, comes into use when the apparatus is reversed for the opposite shoulder.

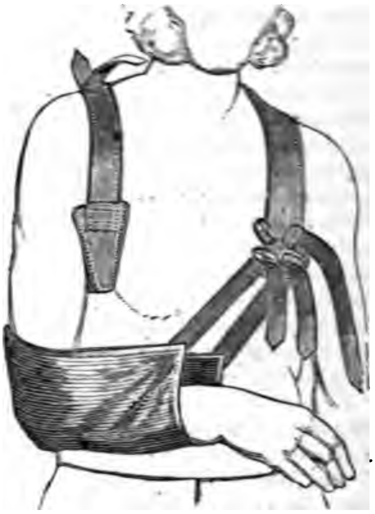
The apparatus of Dr. Levis may be made of any strong material, as drilling, webbing, or soft leather, and its different pieces may be attached together with buckles, or, if more convenient, with buttons, or tapes. Fig. 353 exhibits the various parts of the apparatus, and fig. 354 a front view of its application.

Fig. 353.



Levis's apparatus.

Fig. 354.



The French surgeons were formerly much in the habit of using the stellate or figure-of-8 bandage, represented in fig. 355. It consists of a wedge-shaped pad and a long roller, carried alternately round each shoulder, after which the arm and forearm are secured to the side and front of the chest in the usual manner. The bandage of Desault, once so much employed in this country, has fallen into deserved neglect. Boyer's apparatus for fracture of the clavicle is represented in fig. 356.

Fig. 355.

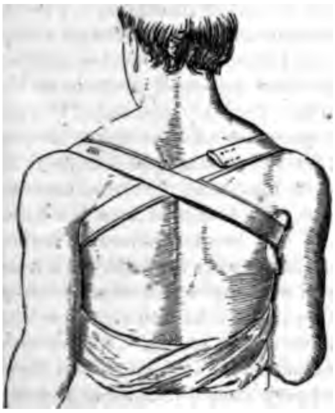
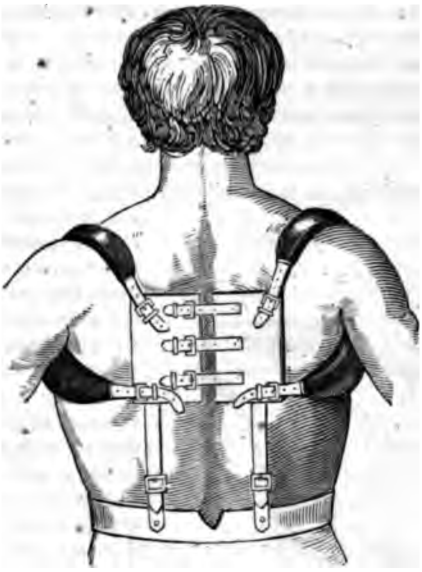


Figure-of-8 bandage.

Fig. 356.

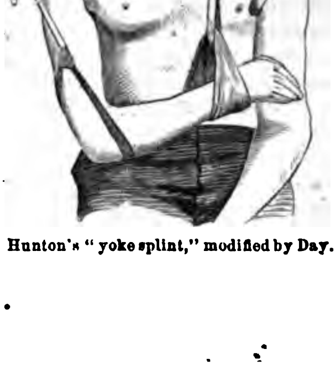


Boyer's apparatus.

Dr. Dugas, of Georgia, is in the habit of treating fractures of this bone without a pad, simply with a triangular piece of thick, unbleached muslin, to each angle of which is attached a bandage from three to four yards in length by three inches in width. The apparatus, which is described at length in the Southern Medical and Surgical Journal for 1852, is applied in such a manner as to form a sling for the elbow and forearm, at the same time that the arm is firmly secured to the side.

When both clavicles are simultaneously fractured, the treatment should be conducted upon the same general principles as when one of these bones alone is broken. Some of our practitioners have derived important aid, under such circumstances, from the use of a yoke, invented by Dr. Hunton, the end of the splint being furnished with holes, and allowed to project several inches beyond the shoulders, thus affording excellent points of support for the tapes of Fox's apparatus. The annexed drawing, fig. 357, represents this apparatus as modified by Day.

Fig. 357.

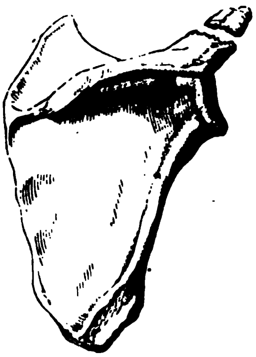


Hunton's "yoke splint," modified by Day.

FRACTURES OF THE SCAPULA.

Fractures of the scapula are extremely uncommon. Of 1,902 cases of fractures of different pieces of the skeleton, treated at the Middlesex Hospital, London, only 18, according to Lonsdale, occurred in the shoulder-blade. At the Hôtel-Dieu, at Paris, the scapula, in 2,358 cases, was broken only in 4. On the contrary, a remarkable disproportion of such cases sometimes occurs in the hands of particular surgeons. Thus, Dr. Dugas has met with four cases of this accident, and Dr. Bulloch, of Savannah, with not less than six, although neither has seen an unusual number of other fractures. The injury may show itself in various forms and directions, and may occupy either of the two processes of the scapula, its neck, its body, or its inferior angle.

Fig. 358.



Fracture of the acromion process.

a. The *acromion process*, fig. 358, being the most exposed portion of the scapula, is more frequently broken than any other part of this bone, the accident being usually caused by a blow upon the top of the shoulder, or by violence applied directly to the process itself. It may also be produced by force transmitted along the humerus by a fall upon the elbow or palm of the hand. There is reason to believe that what is sometimes regarded as a fracture of this process is nothing but a separation of its epiphysis, which frequently fails to coalesce with the rest of the bone until late in life. I have seen quite a number of examples of this kind, and there is not a cabinet, however small, that does not furnish similar proofs. The osseous consolidation is occasionally postponed until after the age of forty. The fracture is generally somewhat oblique, and its signs are so peculiar as to be characteristic. The natural rotundity of the shoulder is destroyed; the outer fragment is drawn down by the weight of the arm, which hangs motionless by the side of the body; the head of the humerus can be felt in the axilla; there is a depression at the situation of the fracture; the distance between the shoulder and the top of the sternum is diminished; and a distinct crepitus may be detected on pushing up the arm in contact with the displaced fragment. In addition to these symptoms there is acute pain at the seat of the injury; the limb cannot be raised by its own efforts; and the patient inclines his head towards the affected side, and supports the forearm as in fracture of the clavicle.

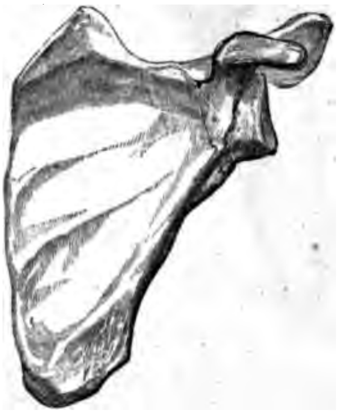
Fracture of the acromion process is distinguished from dislocation of the humerus into the axilla by the circumstance that, in the former, the limb is movable, but fixed in the latter; that the signs of the accident are easily effaced by elevating the arm, but immediately recur when the surgeon lets go his hold, whereas, in dislocation, the reduction always requires a certain degree of force, and does not relapse when it has been effected; in the former, moreover, there is usually crepitus, but not in the latter. In tracing the spine of the scapula, the finger, as it approaches the acromion process, will sink down if there be fracture, whereas the spine will be unusually prominent if there be dislocation.

The *union* is usually ligamentous instead of osseous, owing to the difficulty which is experienced in preserving the contact of the fragments. This occurrence will be more likely to happen when the tip of the acromion is broken off than when the fracture is seated near its root.

The leading indications in the treatment of this lesion are, first, to secure the arm and forearm firmly to the antero-lateral part of the chest; and, secondly, to raise the humerus against the top of the shoulder-joint, so that its head shall serve as a splint for the broken process. For this purpose, the same bandage is used as for fracture of the clavicle, but the axillary pad is dispensed with, lest the broken piece should be pushed too far outwards.

b. In fracture of the *neck* of the scapula, fig. 359, the coracoid process and glenoid cavity are detached from the rest of the bone in an oblique direction. The accident is one of great rarity, so much so that many surgeons have doubted the possibility of its occurrence. It can be produced only by great direct violence, though one case is known where it was caused by muscular contraction in a young lady, in the act of throwing her necklace over her shoulder, the bone having doubtless been exceedingly brittle from some organic defect. The symptoms are always well marked. The acromion is unusually prominent, the head of the humerus is felt in the axilla, the shoulder has a flattened appearance, the limb is lengthened, the coracoid process is thrown down below the clavicle, between the deltoid and pectoral muscles, severe pain and numbness are experienced in the axilla, and a distinct crepitus is perceived on rotating the arm upon the scapula. The accident bears, at first sight, considerable resemblance to dislocation of the humerus into the axilla; but from this it is always readily distinguished by the facility with which the parts may be restored to their natural situation, by the immediate return of the symptoms when the limb is left to itself, and by the existence of crepitus. From fracture of the neck of the humerus it may be known by the circumstance that, in the latter, the shoulder retains its rotundity, and that the limb, instead of being lengthened, is shortened; the acromion also is much less prominent.

Fig. 359.



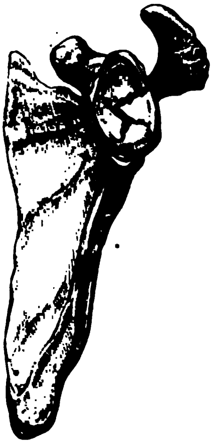
Fracture of the neck of the scapula; according to Sir A. Cooper.

In two cases of this accident, observed by Dr. Dugas, the fracture, produced by a blow upon the shoulder from a falling tree, was instantly followed by paralysis of the limb and cessation of pulsation in all its arterial trunks; a consequence, evidently, of injury done to the axillary vessels and nerves. Treatment having been neglected, no union took place, and the arms have never regained their functions.

This fracture is retained with difficulty, and is liable to be followed by stiffness of the shoulder-joint, atrophy and paralysis of the muscles of the arm, and other disagreeable symptoms. It is managed in the same manner as fracture of the clavicle, a pad being placed in the axilla, the elbow being kept well raised, and the scapula thoroughly steadied until reunion has occurred. If the parts are much contused, leeches, fomentations, and other antiphlogistics may be required. Passive motion should be instituted at the end of three weeks, and renewed every few days afterwards. Consolidation may be expected in two months.

It is not improbable that the edges of the glenoid cavity may occasionally be broken off, either by direct force, or in consequence of the sudden and violent propulsion of the head of the humerus. It is remarkable, however, that the existence of such a lesion has never been demonstrated by dissection. Is it not likely that some of the bad forms of luxation of the shoulder-joint, in which the reduction is maintained with great difficulty, and which are so liable to terminate in permanent anchylosis and ruin of the articulation, are cases of this description? The subject is worthy of greater attention than it has hitherto received. In the annexed cut, fig. 360, copied from Mr. Fergusson, the fracture extends through the glenoid cavity.

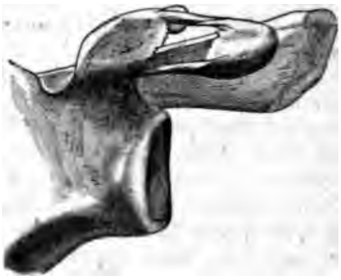
Fig. 360.



Fracture of the glenoid cavity.

c. The *coracoid process* is sometimes broken in consequence of a severe fall or blow, generally a short distance from its tip, the fracture being usually accompanied with evident contusion of the soft parts, and similar lesion of the acromion, clavicle, or humerus. The accident, which is of very rare occurrence, is characterized by inability to raise and adduct the arm, by preternatural mobility, by depression of the detached fragment by the conjoined action of the small pectoral, two-headed flexor, and coraco-brachial muscles, and by the detection of crepitus on moving the arm upon the shoulder, the finger being placed between the deltoid and great pectoral muscles. The adjoining sketch, fig. 361, taken from a preparation in Professor Neill's collection, affords an illustration of a well-marked specimen of fracture of the coracoid process.

Fig. 361.



Fracture of the coracoid process.

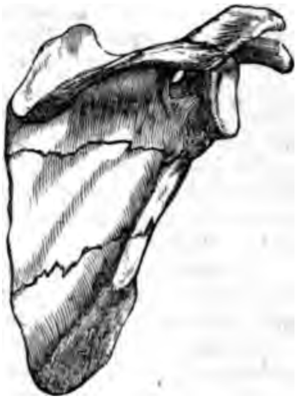
The treatment consists in confining the arm and forearm to the anterior part of the chest by means of a bandage and sling, care being taken to keep the elbow well raised, so as to fix the top of the scapula, and support the broken part. By this procedure, the pectoral and flexor muscles of the arm are relaxed, and prevented from acting injuriously upon the tip of the coracoid process.

Violent inflammation, occasionally terminating in profuse suppuration, and even in death, is apt to follow this accident, owing to injury inflicted upon the pectoral muscles and the axillary vessels, nerves, and glands. The matter being deep-seated, has great difficulty in reaching the surface, and is, therefore, disposed to burrow extensively among the surrounding structures. The proper remedy is an early and free incision at the most dependent portion of the abscess.

d. The *body* of this bone, fig. 362, rarely suffers from fracture, and then only from great direct violence, causing at the same time serious injury in the soft parts. In one case, recorded by a foreign writer, the accident is said to have been produced by muscular action. The fracture exhibits no regularity in regard to shape, is often multiple, and is rarely attended with displacement.

Fracture of the body of this bone occasionally extends through its spine, so as to divide it into two nearly equal vertical parts, as in a case which I saw, in 1860, with Dr. Rohrer. The patient was a strong laboring man, aged thirty-seven, who, in a fall from a scaffold, struck his right shoulder violently against the corner of a plank, fracturing the scapula through its spine and body near its centre. Five days had elapsed when I made my visit. The parts were then much swollen and ecchymosed, the top of the shoulder was depressed and forced forward, and there was a marked irregularity between the ends of the fragments, the outer being drawn downward and forward, so as to form with the posterior a kind of triangle, thus , with distinct crepitation upon the slightest motion. The man was unable to put his hand to his head, but could easily touch the opposite shoulder. He experienced great pain at the time of the accident.

Fig. 362.



The ordinary situation of fracture of the body of the scapula.

To steady the shoulder-blade, which is the leading indication in the treatment of this accident, two large, narrow, and moderately thick compresses should be placed along its axillary and vertebral borders, and confined by a broad roller carried round the upper part of the trunk; or, instead of this, they may be secured by means of large adhesive strips. The arm and forearm are then fastened to the anterior part of the chest, as in fracture of the clavicle.

In the case above described, apposition was easily maintained by a modification of Desault's apparatus.

e. Fracture of the *inferior angle* of this bone is occasionally met with; it is marked by preternatural mobility, by displacement of the smaller fragment by the action of the great serrated muscle, and by acute pain at the seat of the injury. The diagnosis may readily be established by fixing the top of the scapula and moving the lower angle; if they follow each other, it will be an evidence that there is no fracture, and conversely. The treatment is the same as in fracture of the body of the bone.

FRACTURES OF THE RIBS.

The central ribs, from their exposed and fixed position, are much more liable to be broken than the upper and lower; the former being safely protected by the collar-bone, the scapula, and numerous thick and strong muscles, while the latter, from their great shortness and mobility, can readily glide out of the way of any injury that might otherwise affect their integrity. However this may be, they usually yield at their more prominent points, in an oblique direction, a transverse fracture being here, as elsewhere, an unusual occurrence. The accident is most frequent in elderly subjects, children and young persons seldom suffering. The causes are twofold, external violence and inordinate muscular action. The first produce their effect either in a direct or an indirect manner; most commonly in the former, as when the ribs are struck by a fall or blow, or when the body is traversed by the wheel of a carriage. In the second case, the ribs, being impelled by forces operating upon their extremities, break at or near their middle, as when, for example, the back of the chest is pressed against a wall by a railroad car. When these pieces are acted upon directly, their curvature is diminished; but increased when the violence is applied indirectly. I recently attended an old lady who had the eleventh rib of the left side fractured by her granddaughter, a stout girl of fourteen, by throwing her arms round the body, in a friendly embrace, on going to bed. In 1837, a number of persons met with severe injuries of this kind, by being severely squeezed in a crowd in the Champs de Mars, in Paris. A rib has occasionally been broken by mere muscular contraction in the act of coughing, but such an occurrence is unusual, and implies an abnormal condition of the osseous tissue.

The number of ribs broken at any one time is variable. The largest number I have ever met with was eight; sometimes, however, it is still greater. In a specimen in my collection, from the body of a woman, aged upwards of seventy, who threw herself out of a second story window, there are not less than fifty-nine fractures, twenty-seven on the right side and thirty-two on the left.

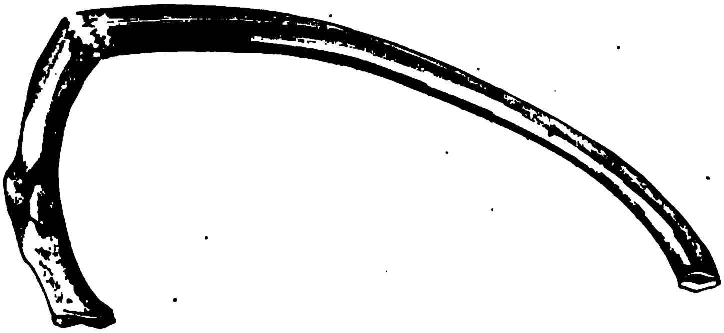
The fracture may occur simultaneously upon both sides, as in the case just mentioned; and it may be either simple, or complicated with other injury, as rupture of the intercostal artery, wound of the soft parts, and laceration of the pleura and lung.

A fracture of the more superficial ribs is often easily detected simply by placing the hand upon the part where the violence is supposed to have been inflicted, and requesting the patient to cough. The bones being thus obliged to undergo a sudden motion, the lesion, if it exist, will be almost sure to show itself by the occurrence of crepitation and preternatural mobility. If, however, the fracture be placed under cover of a large quantity of muscular and fatty matter, as it will be in certain situations in robust and corpulent subjects, the surgeon may find it very difficult, if not impossible, to detect it. Should this happen to be the case, the examination should be repeated again and again, until the diagnosis is satisfactorily determined. The difficulty will be increased if only one rib be broken, or if the broken bone retain its normal position; on the other hand, the diagnosis may be established at a glance if the injury be extensive, and attended with marked displacement, as when it has been inflicted by a fall, or by the kick of a horse. Finally, the patient, as he takes a deep inspiration, is occasionally sensible of a peculiar cracking noise at the site of the fracture.

The pain which attends the fracture of a rib is generally very acute, and, without being strictly limited to the seat of the injury, is always more severe there than anywhere else; it is exasperated by the respiratory movements, and is commonly so violent as to compel the patient to breathe entirely with the aid of the diaphragm. Every attempt at a full inspiration, coughing, or sneezing, is followed by exquisite suffering. In very aggravated cases, the pain resembles that of pleurisy, and is accompanied with intense thoracic oppression. If the lung has been wounded by a spicule of bone, or the projecting end of the broken rib, there will probably be spitting of blood, if not hemoptysis, and, perhaps, also emphysema. In the latter case, the air may fill the cavity of the chest, causing a hollow sound on percussion, and total extinction of the respiratory murmur, attended with great increase of dyspnœa. Should the air escape into the subcutaneous cellular tissue, as when there is injury of the costal and pulmonary pleuræ, it will form a diffused tumor, soft and crackling, and at once indicative of the nature of the case. More or less copious hemorrhage will be present when there has been laceration of an intercostal artery, the blood sometimes passing into the chest, but more generally escaping externally.

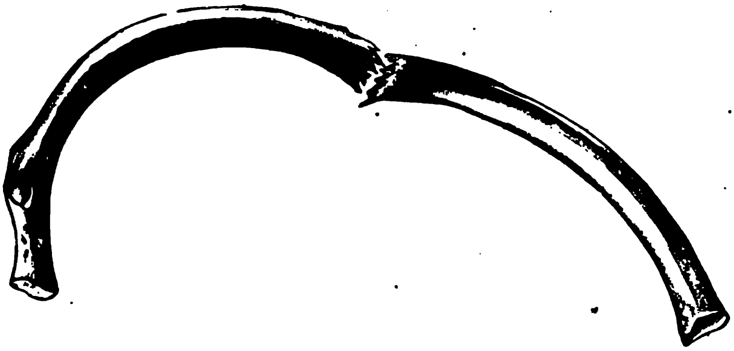
The ribs being firmly connected to the costal cartilages in front, and to the vertebræ behind, it is impossible for them to undergo any shortening when they are fractured, or for the ends of the fragments to overlap each other, as in fracture of the long bones. Derangement, however, may take place in almost any other direction, although the angular displacement is by far the most common, and this may be either outwards or inwards, figs. 363 and 364, according to the manner in which the injury was inflicted, the latter being usually produced by direct violence, the former by indirect. It is seldom, however, that more than one end of the bone is displaced in this direction at the same time. The Mütter cabinet contains several specimens in which one of the fragments projects above the level of the others.

Fig. 363.



Angular displacement outwards.

Fig. 364.



Angular displacement inwards.

Fractures of the ribs are not always devoid of danger, even when they are perfectly simple, or apparently free from all complication. Their number may be so great as to cause severe shock, or such an amount of local and constitutional disturbance as to produce alarming illness and even death. The danger is generally greater, all other things being equal, in fracture of the upper ribs than in fracture of the middle and lower, because a greater degree of violence is generally required to produce it. A fracture complicated with injury of the lung and pleura must be looked upon as a serious occurrence, as it is sure to be followed by more or less inflammation, if not by hemorrhage and pneumothorax. An escape of air beneath the skin is a matter of no consequence, except as indicating serious lesion within the chest. Hemorrhage from a wound in an intercostal artery is usually rather troublesome than dangerous.

The following case, which fell under my observation in August, 1854, strikingly illustrates the danger of fracture involving a number of ribs, without any very serious complication.

Mrs. Hall, of Monmouth, Illinois, a tall, slender woman, aged fifty-four, fell, while the railroad cars were in the act of running off the track, against the top of one of the seats, breaking eight of the ribs on the left side. The second, third, fourth and fifth bones were fractured in front, about two inches and a half from their cartilages, while the eighth, ninth, tenth and eleventh, had given way behind, within a short distance of the spine. There was no displacement of any of the fragments, excepting the posterior one of the tenth rib, which projected slightly inwards towards the chest, and pierced the pleura. Excessive pain, dyspnœa, crepitation, and preternatural mobility, marked the accident. The cough was violent, and the patient was unable to lie in bed. The ordinary treatment was pursued, but without any material benefit, and the woman died at the end of the fourth day, exhausted by her suffering. The left side of the chest contained about three ounces of coagulated blood, evidently furnished by the wounded pleura, but there was no sign of inflammation, except at the seat of the upper fracture, where the serous membrane was a little roughened by lymph and slightly ecchymosed. The lung was free from disease. The other organs were sound.

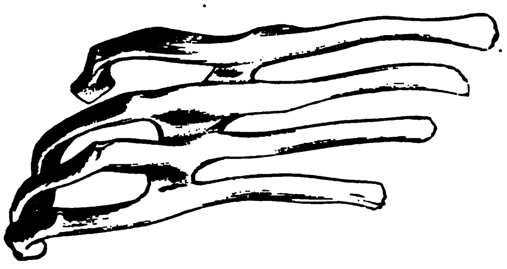
Fracture of the ribs, without complication or displacement, is best managed by encircling the chest with a broad bandage, drawn sufficiently tight to compel the patient to perform respiration chiefly by the diaphragm; the intercostal muscles, and consequently, also, the ribs, being rendered perfectly passive. The bandage should be from eight to ten inches in width, and long enough to extend at least twice around the body. The ends being fastened by two pieces of tape, a scapulary is attached to prevent the cloth from slipping. Or, instead of this, the chest may be surrounded with broad strips of adhesive plaster, arranged so as to overlap each other partially, and drawn with sufficient firmness to keep it perfectly motionless. Female patients may wear, with great advantage, their usual corsets, a triangular piece being cut out in front and below to allow due play to the diaphragm. In addition to the bandage, I usually employ a thin, flat compress, as a small folded napkin, to give greater support to the broken bone.

Similar dressings will answer when there is outward displacement of the fragments, only that it may be necessary to employ a somewhat thicker compress; but how are we to proceed when the end of the broken bone is driven inwards towards the chest, perhaps into the pleuritic sac and the lung? Should it be let alone, or ought we to follow the practice of the older surgeons, and make an attempt to elevate it with the finger, the gimlet-screw, or the trephine? It is evident that counter-pressure by means of thick compresses applied to the extremities of the rib can be of no use. If there be a wound, it might be easy enough to insinuate a small lever, and raise the bone, if not to its proper level, at least out of harm's way. As for myself, I should certainly not meddle with the case, even if the depression were very considerable, unless the symptoms were most urgent, and not then until I had given a fair trial to other means, as the bandage and ordinary antiphlogistics, especially the lancet and full doses of anodynes. If relief did not soon follow, or if the suffering, instead of diminishing, rapidly increased, and it was perfectly obvious from the violence of the pain, cough, and expectoration, that a piece of rib had been forced into the substance of the lung, I should then, I think, not hesitate to make an attempt to raise the offending fragment, or, failing in this, to remove it altogether. Cases requiring such heroic measures must be exceedingly rare, and hardly deserve formal mention in a work of this kind.

Wounds, contusions, and hemorrhage, consequent upon these accidents, must be treated upon general principles. If air collect within the chest in sufficient quantity to cause excessive respiratory embarrassment, it should be let out with a delicate trocar, introduced through a valve-like opening in the skin. Pain and cough are relieved in the usual manner. If the local distress be urgent, leeches may be used, followed by the application of a large opiate plaster. The patient observes the semi-erect posture in bed, and remains within doors until he feels that he can exercise with impunity. If his bandage become insupportable, he must not lay it aside, but simply slacken it.

The annexed drawing, fig. 365, affords an illustration of the manner in which the ribs are sometimes tied together by bony matter after fracture. It was taken from a specimen in my collection.

Fig. 365.



Fractured ribs united by osseous matter.

Cases occasionally occur where the rational symptoms of fracture of the ribs exist, but in which the characteristic signs are absent. Under such circumstances, the rule is to treat the patient precisely as if the bones were really broken.

FRACTURES OF THE COSTAL CARTILAGES.

Fracture of the costal cartilages is so uncommon that a long time elapsed before surgeons were willing to believe it a possible occurrence. That it does take place, however, is a fact fully established by modern observation; and, what is remarkable, experience has shown that it is not always necessary for these bodies to be ossified before they can be broken, although this is usually the case. The accident is invariably produced by external violence, either directly or indirectly applied, and is observed chiefly in elderly subjects. The fracture is usually single, and the pieces which are most liable to suffer are the fifth, sixth, and seventh, owing probably to their great length and to their exposed situation. The direction of the fracture is commonly somewhat oblique; the ends of the fragments often overlap each other, the posterior passing in front or behind the anterior, which, from its connection with the sternum, serves as the fixed point.

The same symptoms which serve to denote a fracture of the ribs will serve to point out one of the costal cartilages. The accident may be simple or complicated, but, in general, it is comparatively free from danger. The broken ends are united through the intervention of a clasp or ferule of bone, in which the cartilaginous tissue remains unchanged. The reduction and maintenance of this fracture are often very difficult, but by a careful observance of the rules laid down in speaking of fracture of the ribs, the surgeon will usually succeed in effecting a cure in six or eight weeks. Malgaigne advises the use of a broad truss for keeping the fragments together, the pad making direct, but gentle pressure upon their extremities. In obstinate cases, the ends of the fragments might be united by the silver wire.

FRACTURES OF THE STERNUM.

This bone may give way in almost any portion of its extent, but more commonly near its middle, the direction of the fracture being generally somewhat oblique. A few instances of longitudinal fracture of the sternum have been observed. Blows, kicks, and falls are the ordinary causes of the accident. Chaussier relates a case where it was occasioned by violent muscular contraction during labor, and several examples of a similar nature have been recorded by more recent observers. In 1858, Dr. Rohrer, of Chestnut Street, had the kindness to show me a case, in a la [illegible] muscular man, aged forty-seven, who met with a transverse [illegible] part of this bone, from inordinate contraction of the sterno-cleido-mastoid muscles, in jumping, while intoxicated, from a shed eleven feet high upon the earth below. The heels striking the surface obliquely, threw the body violently backwards, the head and neck coming in contact with the edge of a board, which projected several inches above the pavement. The fracture no doubt occurred in consequence of the effort which the man made to regain his equilibrium.

The ends of the fragments either preserve their natural relations, or, if there be any displacement, it is in the direction of the thoracic cavity; in which case the broken bone may lacerate some of the contained viscera, cause effusion of blood into the anterior mediastinum, and perhaps induce emphysema by wounding the lungs.

When the fracture is attended with displacement, it may usually be detected at a glance, or by merely passing the finger over the line of injury. Grating, sometimes audible at a considerable distance, and increased at every respiratory effort, is generally present. The pain is excruciating; recumbency is, for a time at least, impracticable; and there is great dyspnœa, along with cough, spitting of blood, and other symptoms of internal injury.

In Dr. Rohrer's case, above mentioned, there was, even several days after the accident, a marked depression at the site of fracture, with considerable irregularity of the ends of the fragments, which was much increased when the patient sat up in bed. During recumbency, when he coughed hard, the hand, placed over the seat of the injury, could distinctly feel the fragments ride over each other, the upper evidently moving more freely than the lower. It seemed as if their edges were beveled off obliquely, that of the lower piece from above downwards, and from before backwards, and that of the upper in the opposite direction. Two or three times, as the man coughed, a distinct grating noise was heard. Percussion upon the spine, immediately opposite the fracture, had also the effect of displacing the ends of the fragments, and a similar result followed when firm pressure was made upon the anterior surface of the fragments. When Dr. Rohrer first saw the case, the upper fragment was thrust backwards towards the thoracic cavity, fully one inch behind the level of the other; but it was easily restored to its natural situation by bending the chest backwards over a thick pillow. The pain at the seat of fracture was comparatively slight; but the suffering in the back of the neck and head was very distressing. There was neither cough nor emphysema, and the fever that followed was slight.

The *prognosis* of fracture of this bone varies according to the mildness or severity of the accompanying lesion. When the thoracic organs have sustained much violence, the patient may die from shock, hemorrhage, or emphysema; or, if he be so fortunate as to survive the immediate effects, he may perish from the secondary consequences of inflammation of the lungs, abscess of the mediastinum, or disease of the bone itself. In the Mütter Museum at the Jefferson College is a skeleton in which a fracture of the sternum, near its middle, had undergone perfect reparation, although not without considerable deformity from the want of accurate apposition. Evidence of fracture exists in a number of other bones, and there must also have been a remarkable predisposition in the individual to the development of exostoses.

The *treatment* of fracture of the sternum is in great measure restricted to the application of a compress and bandage, to afford support to the chest, and assist in securing the quietude of the intercostal muscles. If there be any serious internal complications, local and general bleeding, active purgatives, antimonials, and anodynes, may be required, aided, perhaps, by medicated fomentations. If the fracture be simple, no attempt should be made to rectify depression of the offending fragment, unless it is perfectly certain that it acts as a cause of compression of the heart or lung. In such a case, and also when there are loose pieces of bone projecting into the chest, restoration should be effected at all hazard, and that with the least possible delay. To accomplish this, the patient may lie across a table, upon a kind of double inclined plane, in order to extend the spine, and afford the muscles that are attached to the extremities of the sternum an opportunity of drawing the ends of the broken bone asunder. While this is being done, pressure should be made upon the parts in a direction opposite to that of the displacement, at the same time that the lungs are, if possible, thoroughly distended with air. Or, this failing, the bone, the body being still in this position, may, perhaps, be raised by a small, delicate elevator, used subcutaneously, if a wound was not previously made. If this also prove unsuccessful, I should not hesitate, in view of the urgency of the case, to apply the trephine, or to remove a sufficiency of bone with a Hey's saw. A similar proceeding may become necessary when matter forms in the anterior mediastinum, or when a portion of the sternum is assailed with caries or necrosis.

FRACTURES OF THE VERTEBRÆ.

The vertebræ are so compactly constructed, so strongly articulated, and so thickly covered by muscles as to render their fracture a matter of great difficulty. The most common causes are violent blows or falls, giving rise at the same time to severe injury of the soft parts. Occasionally, but very rarely, the lesion is produced by contre-coup, as when a person falls from a great height and alights upon his feet, the force being transmitted along the extremities and the pelvis to the spinal column, where, concentrating itself upon a particular bone, it breaks its substance or severs its ligamentous connections. Any part of such a bone may give way, its body, plates, and processes being all liable to yield under the influence of the causes here mentioned. The symptoms and effects of this lesion must be considered with reference to the different divisions of the vertebral column, as the cervical, dorsal, and lumbar, each possessing certain peculiarities growing out of its relations with the spinal cord and the nerves which are detached from it.

In fracture of the *cervical vertebræ*, the symptoms vary according to the situation of the affected bone. Thus, if the lesion be above the fourth piece, or the principal origin of the phrenic nerve, and the spinal cord is at all compressed, the diaphragm will be paralyzed, the respiration will be more or less embarrassed, and death will follow, either immediately or within a short time after the accident. If, on the other hand, the fracture is seated below this point, there will be paralysis, to a greater or less extent, of the superior extremities, difficulty of breathing, relaxation of the anal sphincters, incontinence of urine, and tympanitic distension of the abdomen. If the injury done to the soft parts is not very severe, recovery may follow, but in most cases death takes place in from three to five days.

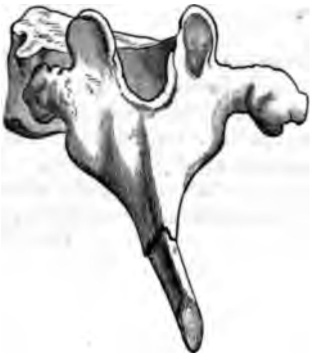
In fracture of the *dorsal vertebræ*, the upper extremities will be free from paralysis, unless the injury is seated very high up, when they may participate in this affection with the sub-diaphragmatic portions of the body. The bowels, in either case, will be torpid and distended with gas, and the bladder will be unable to expel its contents. The patient seldom lives longer than a fortnight, although in some rare cases life is prolonged for several months. In this event, the bowels and bladder may partially regain their original tone, but the urine soon becomes loaded with phosphatic matter, and the lining membrane of the organ suffers from chronic inflammation, adding thus greatly to the patient's distress.

When the *lumbar vertebræ* are broken, the lower extremities are generally deprived both of volition and sensibility, the feces pass off involuntarily, and the bladder is unable to contract upon its contents. Life usually lasts longer than in fracture of the dorsal vertebræ, the paralysis not extending so high up, and consequently not involving so many important organs. In the majority of cases, the patient dies in five or six weeks; but sometimes, though rarely, he survives a much longer time, his bladder, meanwhile, suffering as in fracture of the other divisions of the spine.

The symptoms here enumerated may follow fracture of any portion of a vertebra, except, perhaps, that of the spinous process, where the suffering is generally comparatively slight, unless the lesion is complicated with serious mischief of the spinal cord.

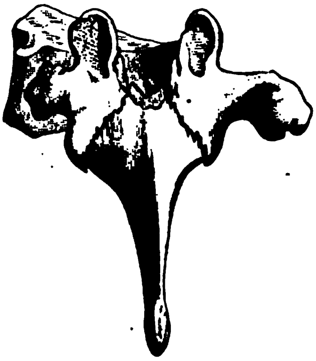
Fracture of the *spinous* processes of the vertebræ occasionally occurs independently of the bodies of those bodies, as seen in fig. 366, the usual exciting cause being a blow, fall, or kick. Preternatural mobility and lateral displacement, with more or less contusion and discoloration of the soft parts, are the most reliable phenomena.

Fig. 366.



Fracture of the spinous process.

Fig. 367.



Fracture of the vertebral arches.

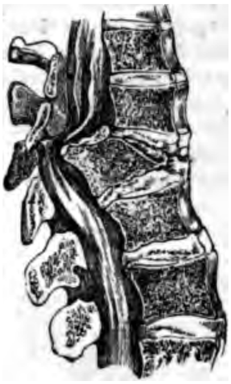
Fracture of the *arches* of these bones, of which the accompanying cut, fig. 367, affords a good illustration, is often comminuted and attended with depression of the fragments, some of which may be driven into the substance of the spinal cord, crushing and pulpifying it. It is generally produced by violence directly applied, and is not unfrequently quite as dangerous as a fracture of the bodies of the vertebræ.

The *transverse* processes of the vertebræ can only be broken, as a general rule, by excessive force, as the passage of a ball, or a fall from a considerable height. Hence the result of such accidents is commonly very unfavorable.

The *diagnosis* of fractured spine is usually rather a matter of inference than of positive conviction. Its most important elements are the mode of production of the injury, and the paralysis of the extremities, but it should be recollected that this symptom may depend entirely upon lesion of the spinal cord, unconnected with fracture of the vertebræ. Owing to the small size of these bones and the manner in which they are covered in by the muscles of the back, it will generally be impossible to detect either crepitation, deformity, or preternatural mobility. All these phenomena may, however, be present in fracture of the spinous processes.

Dissection, after an injury of this kind, will usually reveal more or less displacement of the broken bone, which is sometimes quite comminuted, laceration of the connecting ligaments, and injury of the spinal cord, with more or less extravasation of blood in the spinal canal and the surrounding parts. The cord is compressed, bruised, pulpified, perhaps nearly completely severed, pieces of bone sometimes being imbedded in its substance, as shown in fig. 368.

Fig. 368.



Fracture of the vertebræ.

The *prognosis* of these accidents may be inferred from what has been said respecting their symptoms and effects. If the patient escape immediate destruction, he will almost certainly succumb under his suffering at no very remote period; or, if his life should be spared, he will be doomed to carry on a miserable, bedridden existence, palsied and otherwise crippled in the exercise of some of his more important functions.

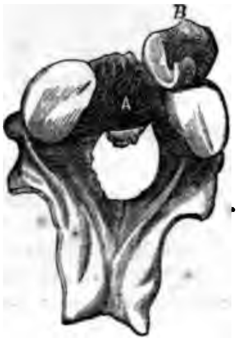
In the *treatment* of this accident, very little is to be done in the way of restoring displaced fragments, all such attempts being not only uncertain, but, even if successful, likely to aggravate the danger by the additional mischief that is inflicted upon the spinal cord. The same remark is applicable to the operation of cutting down upon the injured part, and removing the offending portion of bone with the trephine or saw, as proposed by the late Mr. Henry Cline, of London, and practised by him and other surgeons. In all the cases, amounting probably to ten or a dozen, in which this procedure has been employed, including those of Dr. John Rhea Barton and Dr. Goldsmith, no particular benefit has followed; a circumstance that might have been expected when it is recollected how seriously the spinal cord is generally injured by the depressed fragment. The operation, although not without difficulty, on account of the great depth at which the offending bone is situated, may be executed by any competent surgeon, with but little loss of blood; and, I must confess that, notwithstanding the want of success which has hitherto attended it, I should feel very much tempted to resort to it, if the symptoms were such as to render it certain that the lesion was accompanied by depression.

Whether an operation be performed or not, it is the duty of the surgeon to adopt prompt measures for the prevention of inflammation; with this view blood is taken freely from the arm, and also by leeches from the seat of the injury; the bowels are relieved by purgatives, or stimulating enemas, and pain is abated by full doses of anodynes, combined, if there be much fever, with antimonials. The bladder is carefully watched, and the urine, if retained, is drawn off regularly twice or thrice a day, instead of allowing the catheter to remain permanently in the bladder. The patient should be kept on his back, upon an air-bed, his head resting upon a low pillow, and his position being as seldom changed as possible. Great care is taken that he is not turned upon his face for any purpose whatever, as he might be almost instantly asphyxiated while in this situation, from the imperfect descent of the diaphragm, caused by the pressure of the abdominal viscera, on account of the paralyzed condition of the abdominal muscles, and their consequent inability to offer any resistance to the weight of the body. After the lapse of five or six weeks, the back and limbs should be frequently rubbed with stimulating liniments, and a large issue should be established in the vicinity of the injury with the Vienna paste or the actual cautery. Along with these means, trial may be made of small doses of strychnine, in union with iron and quinine.

When the lesion is confined to the spinous processes, the fragments must be moulded into shape, and retained by two long, thick compresses, stretched along the side of the spine, and secured with a circular bandage, fastened by a scapulary. If the broken pieces, however, be much shattered, so as to preclude the possibility of their reunion, the best plan will be to remove them.

Fracture of the *odontoid process*, although a very uncommon occurrence, is sometimes met with, and, as might be supposed, generally proves promptly fatal from injury done to the spinal cord. Now and then, however, a remarkable exception is found. Thus, in a case related by Professor Willard Parker, the patient survived the accident five months, at the end of which time he suddenly expired from displacement of the process, during some inadvertent movement of the head, a result favored by the destruction of the occipito-axoid ligament. The dissection showed that the odontoid process had been completely broken off, and that its lower extremity had been turned backwards towards the spinal cord, as in fig. 369. The patient was a man, forty years of age, who had been thrown violently from his carriage, alighting upon his head and face, about fifteen feet off. After recovering from the immediate effects of the accident, he was able to resume his business as a milkman, which he followed, diligently and uninterruptedly, every day for four months. He complained, however, constantly, from the time of the accident, of pain in the occipito-cervical region, and was always obliged to support his head, which he was incapacitated from rotating. The only visible deformity was a protuberance of the neck, just below the base of the occiput, to the left of the median line, with a corresponding indentation.

Fig. 369.

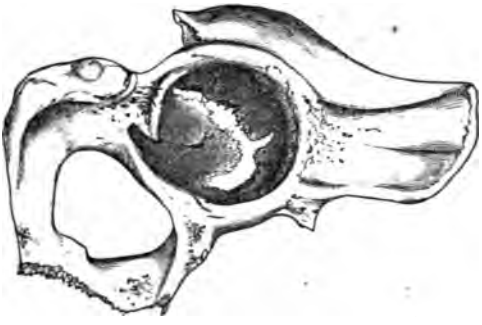


Fracture of the odontoid process of the axis. *A.* Broken surface. *B.* Odontoid process.

FRACTURES OF THE PELVIC BONES.

a. The *innominate bone* may give way in various parts of its extent, but the one which is most apt to suffer is the upper crest, owing probably to its exposed situation. The acetabulum is sometimes broken by a severe blow upon the hip, or by a counter-stroke, as when a person falls upon his knee or foot, thereby driving the head of the femur into the pelvis. In the adjoining cut, fig. 370, from a preparation in the possession of Professor Neill, the fracture runs in a semicircular direction through the acetabulum.

Fig. 370.



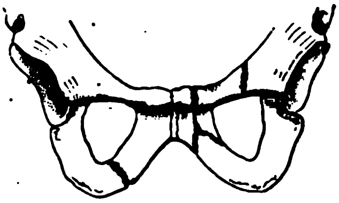
Fracture of the acetabulum.

In young subjects, the innominate bone is occasionally separated at the acetabulum into its three primitive pieces. Whatever may be the site, form, or extent of the fracture, it can happen only through the agency of direct mechanical violence, which, at the same time, generally seriously compromises the soft structures, both outside and inside the pelvis. The most frightful accidents of this kind that have fallen under my observation have been the result of railroad injury, caused by the body being jammed in between a car and a wall, literally crushing the bone, and fatally implicating the bladder and other organs.

The *symptoms* of this accident will necessarily vary according to the seat and extent of the fracture. When the bone has given way at the cotyloid cavity, the nature of the case may usually be recognized by the circumstance that the head of the femur is drawn upwards, and the great trochanter somewhat forwards, so that the limb is diminished in length, and the foot inverted. When the head of the thigh bone is impacted in its new position, the limb may be firmly fixed, as in dislocation, but, in general, it will be found to be more or less movable, and to afford a distinct crepitus when an attempt is made to rotate it.

b. In fracture of the *pubic* and *ischiatic* bones, the corresponding limb is either somewhat shortened, or it retains its natural length; the fragments are pushed either directly downwards, forwards towards the femur, or backwards towards the acetabulum; the patient is unable to sit, stand, or walk; and on placing one hand upon the ilium, and the other upon the pubes, crepitation may usually be perceived. A well characterized fracture of the pubic and ischiatic bones is delineated in fig. 371, from a preparation in the collection of Professor Neill.

Fig. 371.



Fracture of the pubic and ischiatic bones.

c. Fracture of the crest of the *ilium* is characterized by more or less displacement, preternatural mobility, and crepitation; the pain is severe, and progression impracticable. The nature of the accident is sometimes rendered apparent by the existing deformity and by slight manipulation.

Besides the above symptoms, denotive of fracture of different parts of the innominate bone, there is always more or less contusion of the external soft parts, and not unfrequently, also, serious injury of the pelvic viscera, followed by loss of motion of the inferior extremities, retention of urine, and other distressing affections. The prognosis should, therefore, be very guarded, as such accidents are generally fraught with danger, death often occurring in a few days from inflammation or extravasation of urine, or at a later period from abscess, phlebitis, and other mischief.

Owing to their peculiar character, it is usually found very difficult to reduce these fractures, or to prevent relapse after this has been done. To effect restoration, our main reliance must be upon pressure, while the maintenance is best accomplished by well arranged compresses, secured by a body bandage. When no displacement exists, all such dressings may very properly be dispensed with. In either case, the utmost quietude is enjoined; the patient must lie upon his back, his shoulders being elevated, and the thighs flexed, to relax the muscles about the pelvis; inflammatory action is promptly dealt with, and the bowels are relieved by stimulating purgatives and enemas. The bladder is carefully watched, retention of urine being relieved by the catheter.

d. The *sacrum* may be broken by falls, blows, gunshot violence, and similar injury. The fracture is generally discoverable, especially when there is displacement, by mere manual examination, as the patient lies upon his abdomen. It is attended with severe pain at the affected part, and great difficulty in walking, accompanied, when there is lesion of the sacral nerves, with paralysis of the lower extremities, retention of urine, and involuntary discharge of the feces. The danger attending this accident is always considerable, on account of the mischief done to the soft parts; hence, even if the patient survive the immediate shock of the injury, he may perish afterwards from the effects of inflammation of the pelvic viscera.

When there is displacement of the fragments inwards, reposition may be attempted by the insertion into the rectum of a stout bougie, a lithotomy scoop, or a vesical sound, care being taken not to do any injury to the mucous membrane; or, if the displacement be very slight, the bone may be left in its new situation, as no harm can be caused by so doing. Backward displacement may be easily remedied by pressure with the finger, relapse being prevented by a compress and a T bandage. Recovery is promoted by rigid recumbency and antiphlogistics.

e. The *coccyx* is sometimes broken by a fall, by a kick upon the buttock, and by the passage of the child's head in labor. The accident is most common in elderly subjects, in whom the joints of this bone have been destroyed by a deposit of osseous matter. The characteristic signs are preternatural mobility, acute pain, and crepitation on introducing the finger into the rectum. During labor, the occurrence of the accident is sometimes rendered evident by a sense of yielding and a peculiar noise perceived by the attendant as he is engaged in supporting the perineum. If displacement exist, it is remedied by pressure upon the surface and counter-pressure with the finger in the rectum. It is very important, especially in the female, that the coccyx should be preserved in a continuous line with the sacrum, otherwise serious deformity of the pelvis may ensue, interfering with defecation and parturition. After the reduction has been effected, the parts should be supported with a compress, confined by adhesive strips; perfect quietude and lateral recumbency should be observed; and the bowels, without being acted upon at all frequently, should be maintained in a strictly soluble condition.

2. SUPERIOR EXTREMITY.

FRACTURES OF THE BONES OF THE HAND AND FINGERS.

The symptoms of fracture of the bones of the thumb and fingers are so obvious that anything like a formal account of them is quite unnecessary. The treatment is best conducted by a leather, felt, or gutta-percha splint, accurately moulded to the shape of the member and the palm of the hand, to which it must be well secured by appropriate rollers.

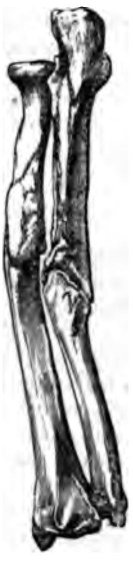
The *metacarpal* bones are sometimes broken by machinery, and I have met with two instances in which the fourth and fifth of these pieces had given way under a blow of the fist, the part struck being, in one of the cases, the face, and in the other the forehead. There was marked displacement upon the back of the hand, from the projection of the anterior fragment, with distinct crepitus and swelling of the soft parts, but hardly any pain. The treatment consisted in the use of a well-padded tin case for the palm of the hand, extending from just above the wrist, and of a short, narrow splint for its dorsal surface; firm pressure being made with it over the seat of fracture. Union occurred in a month, with no apparent deformity.

The *carpal* bones are never broken, except by direct violence, which always seriously implicates the soft parts, not unfrequently necessitating removal of the hand. The nature of the accident is usually apparent from the attendant deformity, the excessive pain, loss of function, and crepitus on manipulation. Reposition of the fragments having been effected by pressure and counter-pressure, retention is secured by means of two splints, either of binder's board or wood, long enough to extend from the middle of the forearm to the ends of the fingers, the hollow of the palm being well padded, and the limb supported in a sling.

FRACTURES OF THE SHAFTS OF THE RADIUS AND ULNA.

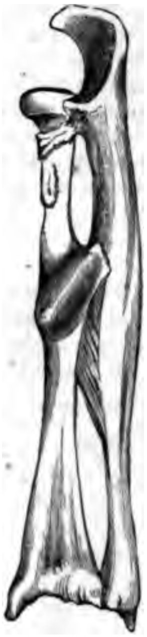
The radius and ulna may be broken conjointly by direct violence, or, as more frequently happens, by a counter-stroke, as when a person falls upon the hand, and the force is concentrated by transmission upon the forearm. The fracture, although it may occur at any point, is most common in the inferior half of these bones, and rarely takes place at the same level, whatever may be its cause. In general, too, it is oblique, and not transverse, as is usually supposed. The nature of the accident is commonly sufficiently apparent from the angularity of the fragments, seen in fig. 372, and their preternatural mobility, to say nothing of the facility of eliciting crepitus on rotating the hand. The patient experiences an inability to supinate and pronate the limb, the forearm is in a state of semi-flexion, and acute pain is felt at the seat of the injury.

Fig. 372.



Mal-approximation of the ends of the fragments in fracture of the ulna and radius.

Fig. 373.



Fracture of the shaft of the radius, with vicious union.

The chief danger in this fracture, as it ordinarily exhibits itself, is from the tendency of the ends of the fragments to sink inwards into the interosseous space, and to become united by a common callus, thereby materially impeding the usefulness of the limb, by destroying the functions of supination and pronation. With ordinary care, however, such an accident is not likely to happen, and, in most cases, the consolidation is completed in from thirty to thirty-five days, without any deformity, or ultimate inconvenience. The vicious union here mentioned is well shown in fig. 373, from a preparation in my collection.

The fracture having been adjusted in the ordinary manner, the forearm is bent at a right angle with the elbow, and enveloped by a roller, extending from the fingers upwards. Two thick binder's board splints are next applied along the anterior and posterior surfaces of the broken bones, and secured with the remainder of the bandage. They should be a little wider than the limb, and long enough to reach from just below the elbow to the extremities of the fingers, both being well covered with wadding, and accurately moulded to the parts. The hand and forearm are then suspended in a broad sling, and confined to the chest in such a manner as that the thumb shall look directly upwards.

In my own practice I have, of late years, entirely dispensed with the compresses upon which so much stress has been laid by practitioners for counteracting the tendency which the ends of the fragments have to approach each other at the interosseous space. I am satisfied that they are not needed for this object, and that all the compression that can be required, at least in ordinary cases, can be effected by the two splints, which are always employed in the treatment of fracture in this situation. The bandage, too, has received a great deal of unjust blame in these cases, it being alleged that, if applied directly to the surface, it will force the bones together, and thus bring on the result adverted to in the foregoing paragraph. It would unquestionably be easy enough to produce such an effect, but it need hardly be added that this would be an abuse, and not a proper use of the bandage, its appropriate office being to afford equable support to the muscles of the broken limb for the purpose of preventing swelling and spasmodic action. Whenever it causes such an amount of compression as to force the fragments towards each other, it cannot fail to excite pain and inflammation, if not still worse consequences. It is the manner, then, in which the application is made, and not the application itself, that is objectionable in the treatment of this fracture. As to the splints, they should be carefully moulded to the shape of the limb, a narrow interval being left between them at its radial and ulnar borders. When the binder's board splints cannot be obtained, light pieces of wood may be used.

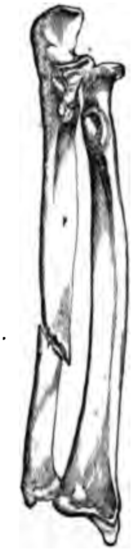
When the fracture is multiple, consisting, for example, of three fragments, the intermediate one having lost its support may have a tendency to sink in towards the interosseous space. To counteract this disposition, a thick, narrow pad may be placed along the mesial border of the loose piece, in an opening in the anterior splint, so as to enable the surgeon to make the pressure more firm and direct. But even here such an expedient will rarely be necessary, if the parts have been moulded into position prior to the application of the apparatus.

FRACTURES OF THE ULNA.

Fractures of the ulna may with great propriety be divided into those which take place at its body, its inferior extremity and its two principal processes, the olecranon and coronoid.

1. *Shaft.*—The body of the bone is most commonly broken in the lower half of its extent, in an oblique direction, as exhibited in fig. 374, from causes acting directly upon the forearm. The accident, may, however, be produced by a counter-stroke; and one instance is known where it was occasioned by muscular action in wringing clothes, the patient being a stout, healthy girl of eighteen. The fracture is evinced by a marked depression at the inner border of the forearm, by the mobility of the fragments, and by the crepitus on rotating the hand. The lower fragment alone is generally displaced, being drawn over towards the interosseous space by the inferior pronator muscle, while the other, in consequence of its firm connection with the humerus, remains stationary. An exception to this is seen in the adjoining figure.

Fig. 374.



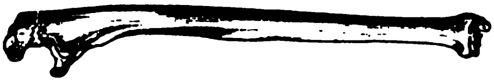
Fracture of the shaft of the ulna.

Great care is necessary in the treatment of this fracture, lest the upper end of the lower fragment retains the vicious position into which it is forced at the time of the accident, and is induced ultimately to become soldered to the inner margin of the radius. To prevent this occurrence, the hand should be permanently inclined towards the thumb, the means for doing this being two splints, the extremities of which are rendered somewhat sloping from behind forwards, in a direction opposite to that of the splints employed in the management of fracture of the corresponding end of the radius. Such an expedient will be much more efficient than the use of the long, thick, and narrow compress, generally recommended for that purpose.

The head of the ulna is sometimes broken off, either separately, or along with the head of the radius. The circumstance is easily detected by the mobility of the part, by the disabled condition of the wrist-joint, by the severity of the pain, and by the concomitant distortion. The treatment is conducted with two splints, aided, if necessary, by two compresses applied directly over the seat of the fracture.

2. *Olecranon Process.*—Fracture of the olecranon, seen in fig. 375, is caused either by direct violence, or by the inordinate action of the three-headed extensor muscle, attached to its upper extremity. Situated at various points of its extent, the fracture may be transverse or oblique, single or multiple, simple or complicated.

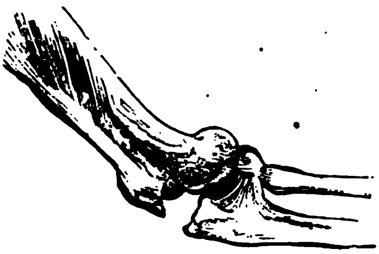
Fig. 375.



Fracture of the olecranon process.

The *symptoms* are, semiflexion of the limb, impossibility of extending the forearm, a hollow at the back of the elbow, fig. 376, and a movable prominence at the postero-inferior surface of the arm, along with more or less pain and swelling. The interval between the two fragments varies from one and a half to two inches, and may be augmented or diminished at will by moving the forearm. The radius may be rotated upon the ulna, and crepitus may be elicited by the approximation of the extremities of the broken bone. Sometimes the very tip of the olecranon is severed, and then there is no separation of the fragments. The same thing may happen when the fracture is oblique, or transverse, provided it is not below the ligamentous expansion of the extensor muscle.

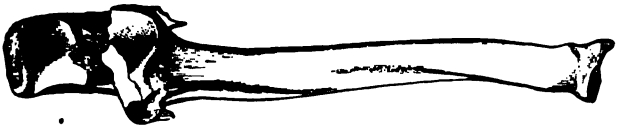
Fig. 376.



Fracture of the olecranon process.

The *union* of this fracture is generally fibro-ligamentous, as seen in fig. 377, from a specimen in my collection. The cause of this kind of union is threefold; first, the want of proper nourishment of the upper fragment; secondly, the difficulty of maintaining accuracy of apposition; and, lastly, the accumulation of an inordinate deposit of synovial fluid, all, but especially the first, interfering with the healing process. I have, in a few instances, seen osseous union; but such an occurrence is extremely rare, and is not at all likely to happen if there be any considerable separation of the fragments, or when the fracture extends through the lower part of the process. The period required for the repair of the injury varies from six to eight weeks, and many months generally elapse before the patient regains a good use of his limb. When the lesion is of a complicated nature, violent inflammation of the elbow-joint may arise, sometimes ending in permanent anchylosis.

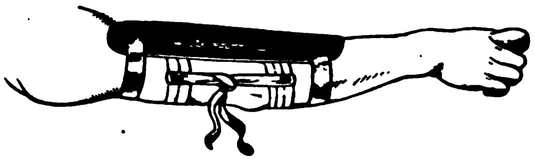
Fig. 377.



Fracture of the olecranon process united by fibrous matter.

The *treatment* consists in maintaining the limb in the extended position; by means of a wooden splint, long enough to reach from the fore part of the middle of the arm to the same point of the forearm, as represented in fig.

Fig. 378.

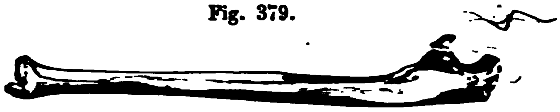


Apparatus for fracture of the olecranon process.

378. A roller having been applied from the fingers upward, the small fragment is drawn into its proper place, where it is confined by a few long adhesive strips and a compress, the whole being firmly secured by carrying the roller round the joint somewhat in the form of the figure 8; or, instead of this, the arm is bandaged from the shoulder downwards, so as to obtain a more perfect control over the extensor muscle, the great agent in effecting displacement. Passive motion is instituted at the end of three weeks, and frequently renewed, to prevent anchylosis. If the fracture is associated with severe injury of the soft parts, leeches, fomentations, and other antiphlogistic measures must be employed.

3. *Coronoid Process.*—A considerable number of cases of fracture of the coronoid process of the ulna, exhibited in fig. 379, have been reported, both

Fig. 379.



Fracture of the coronoid process.

in systematic treatises and in medical periodicals, but it is very questionable whether even a minority of them should be considered as true examples of that lesion. I have myself never met with the accident in the living subject, and I am not aware that a solitary specimen of it exists in any of the osteological collections, private or public, in the United States. Professor Hamilton, who has investigated this subject with his usual care and ability, is very decidedly of the opinion that most of the published cases of this accident are unworthy of acceptance, either because they were badly observed or imperfectly reported, and because the existence of scarcely any of them has been verified by dissection. Some years ago, an instance of reputed fracture of the coronoid process occurred in a young man, a patient in the Louisville Hospital; but, although the symptoms were such as are usually described as characteristic of that lesion, I am by no means satisfied that it really was of that nature. In the case of a boy, about nine years of age, treated by Dr. A. A. Scott, of Missouri, by whom the particulars have been kindly communicated to me, the coronoid process is stated to have formed a distinct prominence upon the anterior and inferior surface of the humerus, a short distance above the joint, movable from side to side, the olecranon being at the same time displaced slightly backwards, and the forearm somewhat flexed. The accident was caused by a fall upon the hand while the arm was forcibly extended.

If we may credit the reported cases of this fracture, it is evident that it takes place mostly in young subjects. It has generally been supposed that it may be caused by inordinate contraction of the anterior brachial muscle;

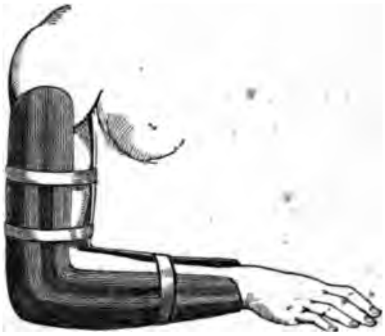
but if any one will take the trouble to examine this muscle at its lower extremity, he will find that it is impossible for it to produce this effect, since the only connection which it has with this portion of the ulna is at the very base of the coronoid process, all the rest of the prominence being entirely free, and therefore beyond the reach of the influence of the anterior brachial. Such an accident might possibly occur in this way if the coronoid process were, like the olecranon, an epiphysis, but this is not the case. Hence the most reasonable conclusion is that fracture of this prominence is always produced either by direct injury, as by the passage of the wheel of a carriage, or, as probably more commonly happens, by force applied to the hand, impelling the ulna and radius violently upwards against the lower extremity of the humerus.

In whatever manner the fracture is produced, the *symptoms* are not generally so clearly marked as one might at first suppose. That this is the fact is sufficiently evident from a study of the reputed cases of the accident, in which the diagnosis has generally been attended with unusual difficulty. The ulna, having lost its purchase in front, will necessarily be drawn backwards and upwards by the action of the three-headed extensor muscle, so that the accident will present all the appearances of a dislocation of the bone in this direction, the prominence of the olecranon being characteristic. The patient is unable to flex the limb, and the detached portion of bone can be felt just above the elbow, where it may be readily grasped and moved about, especially soon after the accident, before any swelling has come on. By bending the forearm at a right angle with the arm, and drawing down the fragment of bone, crepitation might possibly be elicited, but this must, in any event, be very faint and indistinct. The accidents with which this fracture is most liable to be confounded are fracture of the humerus and dislocation of the ulna and radius backwards.

The *union* of this fracture is universally considered as taking place by fibro-ligamentous tissue, and there is no doubt that this is the fact, as appears sufficiently evident when we reflect upon the small size of the detached piece of bone, the difficulty of keeping it in place, its imperfect nourishment, and its close connection with the joint; circumstances which are so many impediments to the formation of osseous matter. In young subjects, and under proper management, a cure may generally be looked for in four or five weeks.

The *treatment* is quite simple, being conducted with a view to the thorough relaxation of the flexor muscles of the arm. For this purpose, the forearm, after having been carefully bandaged from the fingers up as far as the elbow, and the arm from the shoulder downwards, in the opposite direction, is placed at a right angle, as seen in fig. 380, in a tin-case or suitable splints, and supported in a sling, care being taken to prevent the radius and ulna from slipping backwards, away from the condyles of the humerus. The fulfilment of this indication will generally be materially aided by the use of adhesive strips, carried around the joint in the same manner as in fracture of the olecranon. Passive motion should be instituted at the end of three weeks, and perseveringly renewed from time to time, lest anchylosis ensue.

Fig. 380.

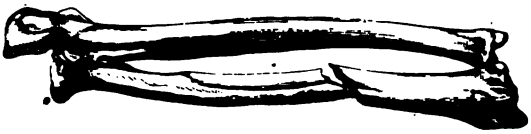


Apparatus for fracture of the coronoid process.

FRACTURES OF THE RADIUS.

1. *Shaft.*—Fracture of the body of the radius may take place independently of that of the ulna, as shown in fig. 381, and is the more frequent accident of the two; its most common seat is the inferior half of the bone, and its ordinary cause a fall upon the palm of the hand. Dr. Packard, of this city, has reported a case of fracture of the upper portion of the radius, caused by violent muscular exertion in driving a pair of horses.

Fig. 381.



Fracture of the shaft of the radius.

The *symptoms* are usually well marked, there being more or less deformity, preternatural mobility, inability to perform the motions of pronation and supination, and the detection of crepitus upon rotating the hand. The ends of the fragments have a singular tendency to approach the interosseous space, and hence, if the case be not judiciously managed, there is apt to be permanent distortion, with partial loss of function of the limb. One of the evil consequences of this tendency is the want of osseous union, or the formation of a false joint within two and a half or three inches of the wrist. I have seen a number of well-marked examples of this kind, and I know of no fracture where an unskilful surgeon may show his ignorance to greater disadvantage.

The limb, being bandaged in the usual manner, is steadied by two splints, extending as far forwards as the extremities of the fingers, the hand being inclined inwards towards the ulna, and maintained in a state midway between pronation and supination. For this purpose, the ends of the splints should be shaped somewhat like the handle of a pistol, as this arrangement will afford an opportunity of bearing upon the radius in such a manner as to force the lower fragment outwards in contact with the superior, thereby counteracting the tendency above alluded to. If this point be strictly attended to, the cure can hardly fail to be perfect. Ordinarily consolidation may be looked for in four weeks.

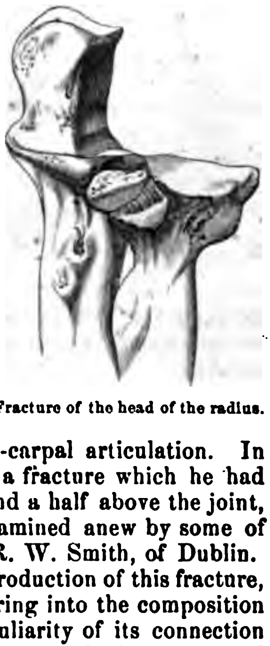
2. *Superior Extremity.*—This bone is occasionally broken at its superior extremity, the fracture detaching its rounded head, or extending through its neck. It is very rarely that the bone gives way at the bicipital tubercle. The injury could hardly be produced in any other way than by direct violence. Owing to the manner in which the parts are enveloped by the muscles, the symptoms are usually indistinct, and the diagnosis is, consequently, rather difficult.

The usual *symptoms* are deformity just below the elbow-joint, caused by the flattening of the muscular prominence in that situation; the projection of the upper end of the lower fragment in front of the limb being drawn thither by the two-headed flexor muscle, impossibility of executing the functions of rotation, and the rapid supervention of severe swelling. To render the diagnosis certain, the best plan is to grasp the head of the radius with the thumb and index finger of one hand, and to rotate the forearm with the other. If there be fracture, its existence will be rendered evident by the head of the bone refusing to obey the motions of the inferior fragment. By adopting this manœuvre, it will hardly be possible to mistake the nature of the case, unless there be so much swelling as to prevent the bone from being felt, in which event the examination must be repeated when the tumefaction has measurably subsided.

In the *treatment* of fracture in this situation, the limb is placed at a right angle with the arm, in a state midway between pronation and supination, and the same splints are employed as in fracture of both bones of the forearm, care being taken to extend them as high up as possible, in order that they shall afford adequate support to the upper fragment. When there is great disposition in the pronator muscle to draw the lower fragment over towards the interosseous space, a compress may be used, but not otherwise.

The annexed drawing, fig. 382, from a preparation in my collection, exhibits a rare form of fracture, in which a portion of the head of the radius has been chipped off, and permanently united to the contiguous border of the coronoid process of the ulna. The specimen was obtained in the dissecting-room, and nothing is, therefore, known of its history.

Fig. 382.



Fracture of the head of the radius.

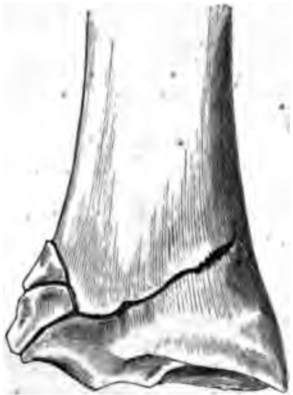
Inferior Extremity.—The frequency of fracture of the lower extremity of the radius, its liability to be confounded with dislocation of the wrist-joint and the imperfect recovery of the functions of the hand which so often follows it, sufficiently attest the importance of the subject, and afford a satisfactory reason for the extraordinary attention that has been accorded to it by modern surgeons. Among those who have particularly interested themselves in elucidating the question, I am happy to mention Dr. John Rhea Barton, who, in a short, but graphic paper, published in the Philadelphia Medical Examiner for 1838, was the first to describe, with any degree of accuracy, the nature and treatment of fracture of this bone at the radio-carpal articulation. In 1814, Dr. Colles, of Dublin, gave an account of a fracture which he had repeatedly found at the distance of about an inch and a half above the joint, and more recently the whole question has been examined anew by some of the French and British surgeons, particularly Mr. R. W. Smith, of Dublin.

Two circumstances powerfully contribute to the production of this fracture, namely, the large amount of spongy substance entering into the composition of the inferior extremity of this bone, and the peculiarity of its connection with the wrist-joint. The relative quantity of this matter in its lower and middle portions, and also the difference in their compact structure, are very striking. These appearances, which are sufficiently conspicuous even in young subjects, are remarkably prominent in elderly persons, in whom the spongy substance of this part of the bone is generally exceedingly rarefied and infiltrated with oily matter, while the compact is often merely a thin crust, hardly as thick as an egg-shell, and scarcely less brittle. The peculiar mechanism of the wrist-joint cannot fail to strike the surgeon. From the intimate manner in which the radius is articulated with the scaphoid and semilunar bones, any shock received upon the palm of the hand is readily communicated to it, causing it, if the force be at all severe, to give way under its influence; whereas the ulna, which has no such close relation, generally escapes without injury.

Fracture of the lower extremity of the radius may happen at any period of life, but is most common in middle aged and elderly subjects. As the result of indirect violence, I have not seen an instance before the eleventh year.

Respecting the *site*, direction, and extent of fracture of this part of the radius, the greatest possible diversity exists. Generally the injury is situated low down, within a short distance of the joint, or within the joint; but the line of fracture is often considerably higher up, as an inch, an inch and a quarter, and even an inch and a half, at the junction, or even beyond the junction, of the lower extremity of the bone with its shaft. Sometimes the seat and direction of the fracture correspond to the line of union of the epiphysis.

Fig. 383.



Multiple fracture of the lower extremity of the radius.

In regard to its *direction*, the fracture is generally oblique, extending from above downwards, and from the dorsal to the palmar surface. Of forty-seven cases analyzed by Mons. Goyrand, of Aix, forty-three were of this description, the degree of obliquity varying much in different instances, the fissure being sometimes almost horizontal.

The fracture of the lower end of the radius is frequently *multiple*, or comminuted; indeed, I am inclined to believe that this form of injury is more common than the simple. In the annexed drawing, fig. 383, from a preparation in the pathological collection of the New York Hospital, there are four fragments, and in several cases I have seen as many as five and six. Occasionally there are two fissures, one transverse, or nearly so, and the other vertical, detaching the head of the bone from its shaft. In Barton's fracture, the lesion always extends through the articular surface of the bone, affecting more particularly its posterior margin, and is frequently attended with separation of the styloid process.

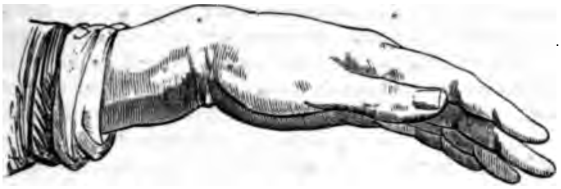
Fracture in this situation may be *complicated*, first with fracture of the styloid process of the ulna, or of the head and shaft of that bone; secondly, with dislocation of the wrist-joint; and, thirdly, with serious injury of the soft parts. Some years ago I attended, along with Dr. Chenowith, a young man in whom this bone was split in two by a transverse and oblique fissure, the larger fragment being completely detached, and thrown forwards and inwards over the ulna, whence, as it was impossible to replace it, I removed it by incision. A good recovery took place with hardly any impairment of the functions of the wrist-joint. In my private collection is a specimen of transverse fracture of the lower extremity of the radius, extending into the joint, and detaching the head of the bone by several small, vertical fissures. In this case I had an opportunity of dissecting the parts in consequence of the removal of the forearm, above its middle, by another surgeon, several weeks after the occurrence of the accident. The hand and wrist were much swollen, and infiltrated with pus, which was also freely diffused through the sheaths of the flexor tendons, while the cellular tissue along the inner part of the palm contained a good deal of blood. The joint was filled with matter, and the scaphoid and semilunar bones, as well as the ulna, which was dislocated backwards, were almost completely divested of cartilage.

The ends of the broken pieces are sometimes *impacted* in this fracture, the superior being driven into the cancellated structure of the inferior; but such an occurrence, although said to be common, is, if I may judge from the cases that I have had an opportunity of examining, quite infrequent. When the force causing the impaction is very great, the inferior fragment may literally be crushed by the superior.

The accident nearly always results from a fall upon the hand, in which the patient, stretching out the limb, receives the shock upon the palm, whence it is transmitted to the inferior extremity of the radius. Occasionally, though much more rarely, the fracture takes place by a fall upon the back of the hand. The lesion is also produced by direct violence.

The most conspicuous *symptom* of this fracture is the singular deformity of the hand, giving the limb the appearance of a dislocation of the wrist-joint, as exhibited in fig. 384. This is owing to the fact that the lower fragment along with the carpus is drawn upwards and backwards, from an inch to an inch and a half above the joint, by the action of the extensor muscles of the thumb, while the upper fragment forms a slight projection on the palmar aspect of the forearm. Immediately above the posterior prominence is a well-marked depression, which gradually slopes off towards the ulna, and is generally sufficiently large to receive the little finger. These appearances are always very striking when the limb is held in a situation midway between pronation and supination, and are easily effaced by extension and counter-extension, although they are promptly reproduced when these forces cease to act. The lower extremity of the forearm has a rounded form, from the increase of its antero-posterior diameter; the fingers are usually flexed, and the patient is unable to supinate the hand, which is, moreover, completely powerless; the pain is excessive, and considerable swelling soon arises, especially along the palmar aspect of the limb. Crepitus may usually be detected by pressure just above the wrist-joint. With these phenomena before him, a surgeon must be exceedingly stupid if he does not speedily detect the nature of the injury.

Fig. 384.

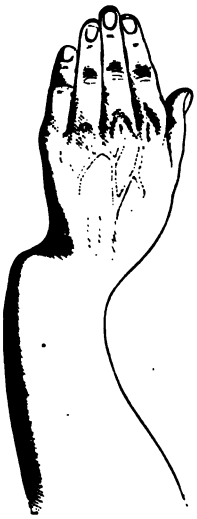


Fracture of the lower extremity of the radius.

Instead of being thrown backwards, the inferior fragment is sometimes forced in the opposite direction, forming a projection in front of the forearm, beneath the flexor tendons. Another tumor, more conspicuous, and consisting of the lower extremity of the inferior fragment of the radius, occupies the dorsal surface; it extends across the entire breadth of the limb, and is bounded above by a well-marked furrow, more distinct internally than externally. The accident, which is exceedingly rare, closely simulates dislocation of the carpus forwards, but may readily be distinguished from it by the presence of crepitus, and the facility with which the symptoms can be made temporarily to disappear under slight manipulation.

The adjoining sketch, fig. 385, represents a fracture of the inferior extremity of the radius, complicated with luxation of the ulna. The signs of both injuries are characteristic. The drawing was taken from a private patient.

Fig. 385.

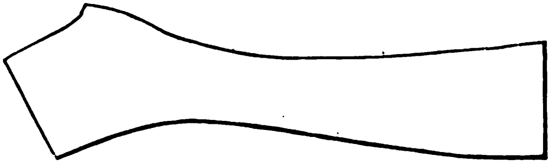


Fracture of the lower end of the radius.

The *prognosis* of this fracture is greatly influenced by the nature of the case and the manner in which it is managed. If, as occasionally happens, there is no displacement, or serious complication, consolidation may be looked for in from twenty-five to thirty days, without deformity or permanent impairment of function. Under opposite circumstances, nothing but the utmost care and circumspection will be likely to insure a successful cure. In any event, the patient must not expect to regain the complete use of his wrist and fingers for several months, as there is a great tendency, in almost every case of the kind, in the resulting inflammation to extend to the synovial membrane of the digital articulations and of the sheaths of the tendons. This fact should always be explained to the patient at an early stage of the treatment, otherwise the surgeon may be unjustly censured for what he cannot possibly avoid.

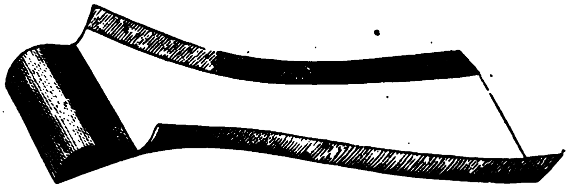
Among the various contrivances for maintaining the contact of the fragments, I may mention, as an excellent one, that devised by the late Dr. Henry Bond, of this city, which I can recommend, from my own experience, as well calculated to fulfil every indication that can be presented by such an injury. It consists, as shown in figs. 386 and 387, of two splints, one of medium-sized binder's board, and the other of thin, light wood, furnished with a block and edges of thin sole-leather, about an inch in height, the whole presenting somewhat the appearance of a shallow trough. They are long enough to reach from a short distance below the elbow to within an inch of the knuckles of the metacarpal bones, the block of the latter resting in the hollow of the palm, and both being well padded with wadding. Having encircled the thumb and each finger with a narrow bandage, the better to control the resulting swelling, and the fracture having been adjusted by pressure and extension, a roller is next passed around the limb as high up as the superior part of the forearm, special care being taken that it shall not produce the slightest constriction anywhere. The splints are then placed in their proper position, and fastened in the usual manner. If there be any tendency to displacement, which, however, rarely happens after the first few days, a narrow, square compress, not more than a third of an inch in thickness, is laid over the projecting fragment, to give greater concentration and effect to the pressure of the apparatus opposite to the seat of fracture. Sometimes it is found necessary to use a compress on each side of the wrist; but such is the accuracy with which the palmar splint fits the parts that this portion of the dressing may generally be altogether dispensed with. There is no use, in any

Fig. 386.



Bond's splint, being the part for the back of the forearm.

Fig. 387.

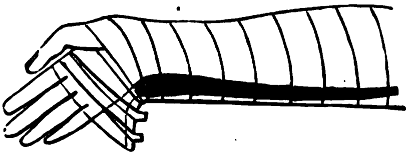


The same, for the front of the forearm and hand.

case, of an interosseous compress, as there never is any tendency in the fragments to inward displacement. The advantage of the apparatus of Dr. Bond is that, while it maintains the thumb perfectly at rest, and consequently prevents its extensor muscles from disturbing the fragments, it permits the patient to move his fingers about freely in front of the block ; a circumstance of no trifling importance in an accident so liable to be followed by inflammation of the sheaths of the tendons. The hand and forearm are, of course, supported in a sling.

In the absence of Dr. Bond's apparatus, a good dressing may be made of two thin pieces of wood, or stout binder's board, a little wider than the forearm, well padded, and of the same length as the preceding, care being taken, in applying them, to fill up the hollow of the hand and the intervals between the splints and limb with cotton. It will also be well, in this case, to give the anterior extremities of the splints a sloping inclination from above downwards, so as to put the extensors of the thumb slightly upon the stretch, as seen in fig. 388.

Fig. 388.



Dressing for fracture of the lower end of the radius.

A very simple but efficient method of treating fractures of the inferior extremity of the radius was recently suggested by Dr. John Swinburne, of Albany, New York. It consists in confining the forearm upon a single splint, stretched along its posterior aspect from the elbow to the metacarpophalangeal joints, and composed of a thin piece of wood, the width of the limb, and provided with two compresses, one of which fills up the concavity of the carpus, while the other supplies the deficiency in the straight line of the arm above. The splint is secured with adhesive strips, the application being commenced at the elbow, and then continued, at intervals of several inches, down the limb to the hand, which, the displaced parts having been previously adjusted, is firmly fastened in such a manner as to allow perfect freedom to the thumb and fingers. The annexed cuts, figs. 389, 390, and 391, afford a good idea of the apparatus and of the appearance of the limb after its application.

Fig. 389.

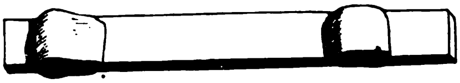


Fig. 390.

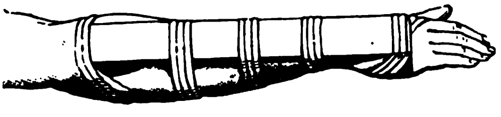
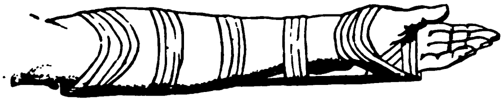


Fig. 391.



Dr. Swinburne's apparatus for fracture of the radius.

The above dressings will answer equally well, whatever may be the character of the displacement, whether backwards or forwards. Passive motion is instituted at the end of a fortnight, proper support being given to the fracture while this is being made. The proceeding is afterwards repeated every other day, until the end of the fourth week, when the apparatus may generally be discontinued, the bandage alone being used. If the joints of the fingers are stiffened, they should receive special attention at each dressing.

FRACTURES OF THE HUMERUS.

Fractures of the humerus are of frequent occurrence, and are of great practical importance, from the difficulty which so often attends their diagnosis and treatment. They may take place in the shaft of the bone, at its surgical neck, at its head within the capsular ligament, and at its condyles.

1. *Shaft.*—The simplest fractures of the humerus are those which occur in its shaft, as they are most easily detected and treated, and least liable to be followed by deformity and loss of function. Caused occasionally by direct violence, they more frequently result from falls upon the palm of the hand, in attempts to save the body from more serious injury. In several instances that have come under my observation, and which are alluded to in another part of this section, the accident was produced by muscular contraction; in one case, while the patient was in the act of throwing a chip. The fracture is usually oblique, a transverse one, properly so termed, being exceedingly uncommon. A complicated fracture of the shaft of the humerus is occasionally met with, as a consequence of the explosion of firearms, the contact of machinery, or the passage of the wheel of a carriage.

The *symptoms* of fracture of the humerus in this situation are usually characteristic, the deformity, preternatural mobility, and crepitus being well marked. In general there is some shortening, but the amount of this varies very much, according to the obliquity of the fracture and the development of the limb; in ordinary cases, it is very slight, the weight of the arm being sufficient to counteract the action of the muscles, at least to a considerable extent. The direction of the displacement is regulated by the line of fracture; if this is below the insertion of the deltoid, the inferior fragment will be drawn inwards, but outwards if it be above that point. However this may be, any deformity that is present is easily effaced by extension and counter-extension. The limb is completely powerless, and is always supported by the patient at the wrist.

The *treatment* of this fracture is very simple, the only apparatus necessary being two splints, and a roller applied from the fingers up. The splints may consist of two stout pieces of unoiled sole-leather, or binder's board; one extending from the axilla to within an inch of the internal condyle, and the other from the shoulder-joint to the corresponding point of the outer condyle, the two, when applied, nearly meeting each other. By soaking them in hot water, they may be accurately moulded to the shape of the limb, and, when this is done, it is impossible to conceive of anything better adapted for the treatment of such a case. The forearm and hand are, of course, supported in a sling, and, for the sake of greater security, the arm may be fastened by a few turns of a bandage to the side of the trunk, though this is not at all essential. Special care is taken not to raise the elbow, as a certain degree of weight is necessary to prevent overlapping of the fragments. This mode of dressing fractures of the shaft of the humerus I have practised for many years, and it requires no argument to show its superiority over the old four-splint apparatus, still used by many surgeons. If the lesion be simple, reunion will generally occur in a month.

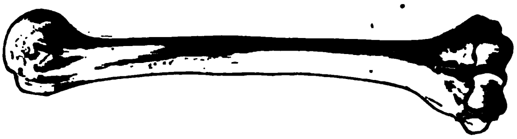
2. *Inferior Extremity.*—Fracture of the condyles may be caused by a fall upon the point of the elbow, by a blow, or by the passage of the wheel of a

carriage. I have repeatedly known it to be produced by a fall upon the palm of the hand, the limb being at the time in an extended position. The accident may be simple, or, as not unfrequently happens, complicated with serious mischief to the joint and soft parts. Both condyles may be broken, or one only may be affected. In the former case, a longitudinal fracture usually extends some distance along the centre of the bone, and then terminates, probably at a distance of an inch and a half to two inches above the joint, in an oblique or transverse fissure in the lower portion of the shaft of the humerus, thus producing three fragments. Not unfrequently, however, there is a separation merely of one of these prominences, the fracture being then usually directed obliquely downwards into the joint. In a third series of cases, the small projection over the inner condyle is broken off, either obliquely or perpendicularly, without any involvement whatever of the articulation.

The *symptoms* of fracture of this portion of the humerus vary according to circumstances, as might be expected from a consideration of the structures of the elbow-joint. When both condyles are severed just above the articulation, the radius and ulna project backwards, a hollow exists at the bend of the arm, the forearm is slightly flexed, and the distance between the elbow and wrist is sensibly diminished. When the fracture involves both the condyles and the inferior extremity of the shaft of the bone, there will be, in addition to these phenomena, an increase in the width of the bend of the arm, and an appearance of greater flattening. The accident, whether accompanied by this occurrence or not, is liable to be mistaken for dislocation of the radius and ulna backwards; but the diagnosis may generally be readily determined by the fact that the symptoms which mark the former lesion promptly disappear on extending the limb, and that crepitus may be produced when the forearm is rolled upon the humerus.

When the inner condyle alone is detached, as exhibited in fig. 392, the ulna projects backwards, but resumes its natural position on extending the limb; the condyle forms a tumor at the back part of the elbow; crepitus is perceived on bending the forearm; and, if the forearm be extended, the humerus will advance in front of the ulna as the latter recedes.

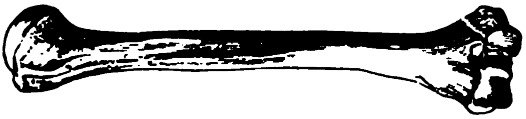
Fig. 392.



Fracture of the internal condyle.

A fracture of the external condyle, shown in fig. 393, is characterized by the existence of a tumor at the outer and back part of the elbow, by crepitation on rotating the radius, by the supine position of the hand, by inability to move the joint, and by the constant semiflexion of the forearm.

Fig. 393.



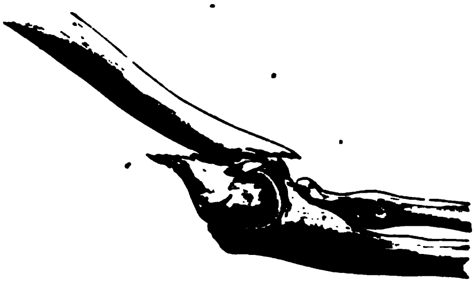
Fracture of the external condyle.

When the tubercle over the internal condyle is broken off, the diagnosis is easily established by the great mobility of the fragment, the ready production of crepitus, and the other ordinary signs of fracture. The accident is usually caused by a fall upon the elbow, and is unaccompanied by any displacement of the bones of the forearm.

Whatever may be the nature or extent of these fractures in the vicinity of the elbow-joint, there are always severe pain and complete inability to move the limb. Considerable swelling soon follows, and effusion rapidly takes place within the articulation, obscuring the characteristic features of the injury, and rendering the diagnosis proportionately difficult. When such a state of things exists, leeches, fomentations, and other antiphlogistic measures may be necessary before the parts will be sufficiently tolerant of the requisite manipulation.

The inferior extremity of the humerus occasionally gives way just above the condyles, generally in a more or less oblique direction, as seen in fig. 394. Such an occurrence may, unless great care be taken, be readily confounded with dislocation of the ulna and radius backwards, which its symptoms, at first sight, closely resemble. The signs of distinction are, the mobility of the limb, and the facility with which the parts can be restored to their natural position, followed by the immediate return of deformity upon discontinuing the extension. The accident, which should be treated on the same principles as fracture of the shaft of the humerus, is extremely liable to be followed by stiffness of the joint.

Fig. 394.



Fracture of the lower end of the humerus.

In children, prior to the completion of the ossific process, there is sometimes a separation of the epiphysis of the inferior extremity of the humerus, induced by falls upon the hand or elbow. The symptoms resemble those of fracture in this situation in the adult, there being an unnatural projection at the back of the joint, caused by the retraction of the lower fragment along with the bones of the forearm, and the ready production of crepitus on extending the limb. The accident is treated as if it were a fracture.

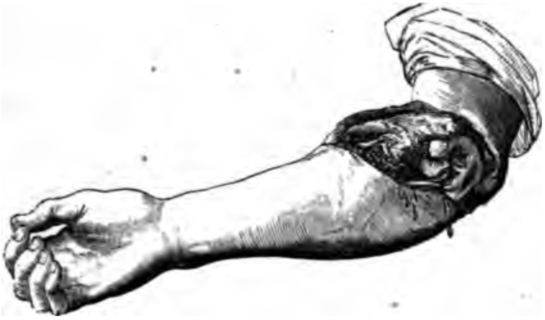
I know of no fractures which I approach with more doubt and misgiving than those of the inferior extremity of the humerus, involving the elbow-joint. I know of none which are more liable to be followed by severe inflammation of the synovial membrane, extensive effusion, anchylosis, and deformity. Even in the more simple forms of these injuries, and where the treatment has been most skilfully conducted, there is generally great risk of an unfavorable result; at all events, a long time will be sure to elapse before there will be anything like a good use of the articulation. The prudent surgeon will, therefore, inform his patient, at the commencement of the attendance, of the nature and probable consequences of the case. From five to six weeks is the average period necessary for the reunion.

The nature of the deformity, in badly-treated fracture of the condyles of the humerus, may exhibit itself in quite a variety of ways, depending upon the peculiar mode of treatment. Sometimes a posterior projection remains, caused by the displacement of the lower end of the bone backwards; not unfrequently the limb has a strangely twisted appearance, either in the direction of pronation or supination; occasionally it is permanently flexed or extended; and sometimes, again, the limb is greatly increased in breadth.

Most practitioners, I believe, are agreed upon the propriety of treating these fractures with the limb in the flexed position. I know of but few that pursue the opposite plan, and the arguments which they have adduced in its favor have by no means convinced me that it is at all equal to the other method. It is but just to say, however, that I know nothing of its comparative merits from experience, inasmuch as I have never, in a solitary instance, adopted it, having always been satisfied with the rectangular position. To maintain the limb in this situation, I have long been in the habit of employing a light and well-shaped tin-case, extending from the axilla to the metacarpo-phalangeal articulations. This, being properly lined with wadding, affords an admirable support to the limb, and effectually prevents displacement of the fragments, whatever may be their size or number. Great care should be taken to protect the inner condyle from pressure, otherwise it may become seriously inflamed, if not ulcerated. To obviate this occurrence, a small gap may occasionally be made with advantage in the case, opposite this ledge of bone. A case made of gutta percha, felt, thin wire, or sole-leather, answers quite as well as one of tin, and is even superior to it, inasmuch as it admits of more accurate adaptation to the irregularities of the limb. The forearm is supported in a sling, in a state midway between supination and pronation.

There are no fractures which require more constant vigilance after their adjustment than those about the elbow-joint. The dressings should, therefore, be examined for some time, from day to day, in order that they may be changed whenever they become either too tight or too slack, and especial pains must be taken that the bandage, in the first instance, is applied very loosely, due allowance being always made for the resulting swelling. If some time have elapsed since the occurrence of the injury, and the pain and tumefaction are very severe, measures should be used to reduce the inflammation before the limb is put up. Passive motion is commenced at the end of two weeks, and repeated every forty-eight hours until all danger of anchylosis is passed. As soon as the fracture is sufficiently repaired to bear the change, the rectangular apparatus is taken off, and a more obtuse one substituted in its place.

Fig. 395.



Complicated fracture of the elbow.

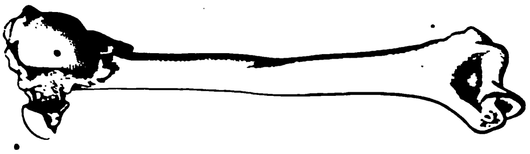
Fractures of the elbow are often of a *complicated* character, fig. 395, especially when caused by railway injury, or falls from a great height, penetrating the joint, extensively lacerating the soft parts, and, perhaps, comminuting the bones. Such accidents are always fraught with danger, both to limb and life, and usually promptly require amputation. Even supposing that the limb could occasionally be saved under such circumstances, the patient's recovery will be extremely tardy, and when, at length, he does get well, it will be found, as a general rule, that the joint will be worse than useless; only serving as a hindrance.

3. *Superior Extremity.*—The superior extremity of the humerus includes the hemispherical head of this bone and its two necks, the anatomical and surgical; the former being the narrow, constricted portion between the head and its tuberosities, and the latter all that portion which intervenes between these prominences and the insertion of the broad dorsal muscle, its length varying from an inch and a half to two inches, according to the stature of the individual.

a. Fracture of the Head.—Fracture of the head of the humerus is an extremely uncommon occurrence, so much so, indeed, that its possibility was for a long time a matter of controversy among surgeons. The cases, however, that have been reported by Bichat, Astley Cooper, Dorsey, Gibson, R. W. Smith, Malgaigne, and others, have effectually dispelled all doubt upon the subject. I saw, myself, many years ago, in a patient of Dr. George McClellan, an instance of the kind, which had been mistaken by the attendants for a fracture of the acromion process, and the true nature of which was not detected until several years after the occurrence of the accident, when the man, who was upwards of forty years of age, died of another disease, and an opportunity was thus afforded of examining the parts. The fracture had extended obliquely from above downwards through the head of the bone; and, although it had become perfectly consolidated, there were several rough prominences which, while they unmistakably indicated the seat of the injury, greatly impeded the movements of the shoulder-joint. The accident had been caused by a fall from a carriage.

In a specimen in my private collection, obtained from the body of an insane woman, upwards of seventy years of age, whose skeleton presented the appearance of having been broken in numerous places, the head of the humerus is completely detached from the anatomical neck, the articulating surface, which retained its smooth and polished aspect, being tilted over the great tuberosity against the posterior surface of the bone, to which it is firmly and inseparably united by osseous matter, the fracture having evidently happened a long time before death. Directly opposite to the prominence thus formed, on the inner surface of the humerus, is another large projection, fully an inch in length, having the character of a stalactitic exostosis. The bicipital groove is completely effaced. The whole bone is extremely light, its weight being hardly two ounces and a half. The annexed cut, fig. 396, conveys a good idea of the distinguishing features of this remarkable, if not unique specimen.

Fig. 396.

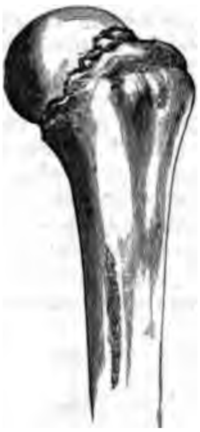


Fracture with detachment of the head of the humerus.

When the head of the humerus is completely detached from the tubercles along the anatomical neck, it must necessarily act as a foreign body, speedily perishing from the want of nourishment. In some cases, however, it is eaabled to preserve its vitality, although imperfectly, by remaining in connection with the rest of the bone through the intervention of a few bands of fibrous tissue.

b. Fracture of the Anatomical Neck.—In children, prior to the completion of ossification, the head of the humerus is occasionally separated from the shaft of the bone, very near the point of attachment of the capsular ligament, or at the anatomical neck. The accident is generally caused by a fall on the elbow, or by violence applied to the shoulder, and is very liable to be mistaken for other injuries. In old persons, the head of the bone, fig. 397, is sometimes not only broken off, but thrown down into the axilla, where it forms a distinct tumor that can easily be felt by the hand, but which does not obey the movements of the arm. Such an accident always seriously complicates the case.

Fig. 397.

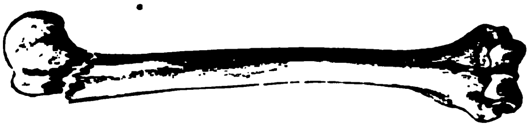


Fracture of anatomical neck of humerus.

Intra-capsular fracture of the humerus is occasionally *impacted*, the upper fragment being propelled into the inferior. The occurrence, which is extremely uncommon, is met with exclusively in old subjects, laboring under atrophy and great fragility of the osseous tissue. The head of the bone can be felt in the glenoid cavity, there is a slight hollow below the acromion, the axis of the arm is directed inwards towards the coracoid process, and the elbow is somewhat separated from the trunk. Crepitation is either very faint or entirely wanting. The length of the humerus is diminished, but generally in so slight a degree as to render it unavailing in a diagnostic point of view.

c. Fracture of the Surgical Neck.—Fracture of this portion of the humerus is uncommon, but may take place from the same causes as fracture of the shaft of the bone; sometimes from a fall upon the hand or elbow, sometimes from direct violence, and sometimes, although rarely, from muscular action. The injury is always attended with marked displacement, forming an important feature in its history. The superior fragment, yielding to the influence of the spinate muscles of the scapula, is generally drawn outwards and slightly forwards, while the inferior one is directed inwards towards the side of the trunk by the pectoral, broad-dorsal, and large teres muscles, attached to the inner border of the bicipital groove. At the same time that this portion of the humerus is dragged inwards, it is usually somewhat raised by the joint agency of the muscles that pass from the scapula to the forearm; the extent of the displacement, however, is commonly trivial, inasmuch as the weight of the limb is almost sufficient to counteract its occurrence.

Fig. 398.

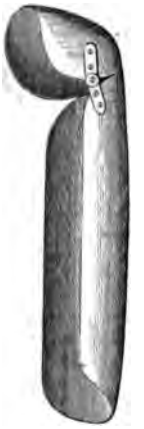


Fracture of the surgical neck of the humerus.

The *diagnosis* of these different fractures is not always so easy as might, at first, be supposed. Their character is often greatly obscured by the swelling, and the consequent difficulty of making a thorough examination. In general, there is marked deformity at the shoulder-joint, the deltoid muscle is flattened, the arm is twisted upon its axis, and, if t [illegible] situated on the outside of the capsular ligament, there is usually slight shortening of the humerus, with distinct projection of the upper end of the lower fragment. If extension and counter-extension be made, so as to draw the parts in place, crepitation will be elicited, followed by a recurrence of all the previous symptoms the moment the surgeon relinquishes his hold. In all cases of doubt, it will be a good plan to grasp the head of the humerus firmly with the thumb and fingers of one hand, while with the other we seize the elbow and move the arm on its axis. If fracture be present, it will almost be sure to be detected by the crepitation produced by the manœuvre, whereas, if there be a dislocation, no noise will be perceived, and there will also be little or no mobility. When the head of the bone is fractured, and thrown off the glenoid cavity, the symptoms will be of a compound character, the crepitation and abnormal mobility co-existing with flattening of the deltoid muscle, extraordinary saliency of the acromion process, and a remarkable fulness in the axilla, caused by the presence of the displaced bone, at the same time that the upper extremity of the inferior fragment projects prominently upwards and inwards.

Treatment.—Fractures of the superior extremity of the humerus must all be treated upon the same general principles as fractures of the shaft of the bone. The limb being bandaged from the fingers up, two splints, broad and hollow, made of unoiled sole-leather, binder's board, gutta-percha, or gum sheeting, are applied, one on the outside, and the other on the inside of the limb, the former being long enough to extend from the external condyle to the top of the shoulder, which it should cover well in, since it is of paramount importance to give firm support to the broken parts, as in fig. 399. The inner splint should be carefully padded at its superior extremity, in order that it may not chafe the skin or exert any disagreeable pressure upon the axillary vessels and nerves. No cushion will be required for the axilla. The arm is carefully secured to the side of the chest, and the forearm is supported in a sling, but the elbow is left free, in the hope that its weight will tend to prevent overlapping of the fragments. Passive motion is instituted at the end of the third week, and firm union may reasonably be expected in a fortnight more. A long time, however, will elapse before the joint will completely regain its functions, if, indeed, it ever does. Permanent lameness will almost be inevitable, if the fracture be intra-capsular and comminuted, owing to the difficulty of readjusting the fragments.

Fig. 399.



Welch's shoulder splint.

When fracture of the superior extremity of the humerus is complicated with *dislocation*, the proper plan, of course, is to restore the displaced bone to its natural position before an attempt is made to readjust the ends of the fragments. The operation, however, will necessarily be one of extreme difficulty, on account of the shortness of the superior piece, which thus deprives the surgeon of the advantage of a suitable lever. His whole reliance must, therefore, be upon well-directed pressure and counter-pressure, while the patient is fully under the influence of an anæsthetic, complete muscular relaxation being of paramount importance to success. When the operation fails, it has been recommended to let the dislocated head of the bone remain in its unnatural situation, and to bring the upper extremity of the lower fragment in contact with the glenoid cavity, in the hope that, in time, as the bone becomes rounded off, it will contribute to the restoration of the motion of the limb. Such an idea, however, it seems to me, must be perfectly delusive; for it is impossible to see how, under such circumstances, nature could make anything like a good or useful joint. Instead, therefore, of pursuing such a practice, I should not hesitate, if a case of the kind were to present itself to me, to cut down upon the dislocated bone, and push it back into its natural position. The broken pieces being placed in contact, and the wound carefully closed, I should not apprehend any bad results from inflammation and its consequences. Excision of the head of the humerus is seldom followed by serious effects; and, although the two cases are not exactly parallel, yet I should neither expect to lose my patient, nor make him a stiff joint.

Fractures of the surgical neck of the humerus are occasionally *impacted*, the upper extremity of the inferior fragment being forcibly driven into the cancellated structure of the lower end of the superior fragment. Such an occurrence is most common in old subjects, after the age of fifty-five, in consequence of interstitial absorption of the osseous tissue, and may be produced either by a blow upon the shoulder, or, what is more common, by a fall upon the elbow. The extent of the impaction varies from a few lines to half an inch or more. As the bone retains its continuity, the symptoms of the accident are usually very obscure, there being neither mobility nor crepitation, unless the fragments are unlocked by being forcibly pulled asunder. Nevertheless, there is generally some deformity, perceptible upon firmly grasping the humerus, and an alteration in the axis of the limb, which often looks as if it were twisted, together with severe pain, and usually also more or less contusion of the soft parts. If the impaction be extensive, there will, in addition, be some degree of shortening of the arm, or a slight diminution in the distance between the shoulder and elbow. These circumstances, conjoined with the fact that the patient has received a severe injury, that there is loss of motion in the joint, and that all the symptoms of dislocation are absent, afford sufficient evidence of the probable nature of the case.

The impacted fracture requires no special treatment on its own account. Experience and common sense alike dictate the propriety of letting it alone. Nothing, certainly, can be gained by pulling the fragments forcibly asunder, except mischief and trouble. Instead, then, of such interference, the surgeon contents himself with supporting the limb, and combating inflammation by leeching, fomentations, and other means; taking care, in due time, to institute passive motion, lest anchylosis should arise.

d. Great Tuberosity.—Fracture of this portion of the humerus, although uncommon, is probably not quite as infrequent as is generally supposed, the obscurity of its symptoms rendering it extremely apt to be mistaken for other lesions in and around the scapulo-humeral articulation. The accident is liable to occur at almost any period of life, except, perhaps, in early childhood, and is always caused by a fall or blow upon the forepart of the shoulder, the force being concentrated upon the upper extremity of the humerus so as to separate the large tubercle from the hemispherical head and shaft of the bone. The existence of the fracture is denoted by considerable flattening of the deltoid muscle, by a remarkable increase in the width of the upper portion of the arm, which is nearly double what it is in the natural state, and by the presence of two osseous prominences, one of which, consisting of the detached tuberosity, is situated at the superior and outer part of the joint, and the other, formed by the head of the humerus, at the upper and inner part. The acromion is abnormally salient, and the arm is separated from the side, but can be approximated to it without difficulty, and in fact readily pronated in every direction by the surgeon.

The most important *diagnostic* signs are the great increase in the breadth of the articulation, the refusal of the thumb to sink into the glenoid cavity, as it always does in dislocation of the shoulder, the preservation of the length of the limb, and the production of crepitation upon rotating the humerus by seizing it just above the elbow while the surgeon encircles the head of the humerus with both hands. Another important evidence is the fact that the deformity is readily effaced by manipulation, but instantly reappears when it ceases.

Reparation, generally of an osseous character, is effected in from four to six weeks, according to the age of the patient, and the amount of the resulting inflammation, which is always very considerable, in consequence of the concomitant contusion of the soft parts. Owing to this circumstance, the motions of the joint usually remain imperfect for many months; and in not a few cases, even when the greatest vigilance is exercised, they are never completely regained, owing to a redundancy of callus and the formation of osseous excrescences around the articular surfaces.

In the *treatment* of this fracture, one of the leading indications is to neutralize the action of the muscles which are attached to the tubercles of the humerus, the larger one receiving the insertion of the two spinate and the small teres, and the lesser the subscapular, which necessarily tend to draw the fragments away from each other, the subscapular being materially aided in this by the action of the broad dorsal, the great pectoral, and the short head of the flexor of the arm. To accomplish this object, the limb is put up in two leather splints, the inner one of which is nicely padded above to prevent undue pressure upon the axillary vessels and nerves, while the outer one should be bent well over the top of the shoulder. No cushion will be necessary, especially if the precaution be used of securing the arm and forearm properly to the chest. The elbow is carefully supported in a sling, but not so firmly as to push the head of the bone too high up towards the acromion process. For the first five or six days after the accident, leeches and fomentations may be required, and passive motion should be instituted in three weeks.

3. INFERIOR EXTREMITY.

FRACTURES OF THE FOOT.

Fractures of the bones of the foot do not require any special notice, as their management is conducted upon the same principles as that of fractures of the hand. From the fact that they are generally complicated, the treatment must be largely antiphlogistic, and the surgeon will have cause to congratulate himself if he is not occasionally obliged to amputate the foot, or exsect some of its bones. It need hardly be added that any loose and displaced fragments should always be promptly removed, even when there is no external wound, and when it might be perfectly easy to effect replacement; for such pieces would not only be likely to act as foreign bodies, but they might, in the event of vicious reunion, seriously interfere with the wearing of a boot.

The *calcaneum*, or heel-bone, notwithstanding its exposed situation, the importance of its functions, and the manner in which it lies beneath the tibia and fibula, is seldom the subject of fracture, Direct violence is the most common cause of the accident, which is often attended with severe lesion of the neighboring structures, both soft and hard. Falling from a great height, in which the person alights upon his heel or foot, is the manner in which it commonly happens. The bone being thus forcibly acted upon, on the one hand, by the weight of the body, and, on the other, by the resistance offered by the surface struck, yields at its weakest point, breaking, perhaps, into several pieces. More rarely the accident is produced by the inordinate contraction of the muscles of the calf, as in dancing and leaping; but in this case it is only the posterior extremity of the bone that suffers, its tip being the part generally torn off. The amount of displacement varies according to circumstances, being necessarily very slight when the fracture extends across the body of the bone, whereas it is always very considerable when it involves its back part, on account of the action of the gastrocnemial muscles, which, exerting their influence through the tendo Achillis, sometimes draw up the posterior fragment from an inch and a half to two, three, four, and even five inches. Authors speak of an impacted fracture of the calcaneum, but such an occurrence must be extremely uncommon.

The *signs* of this fracture are always sufficiently characteristic when the posterior portion of the bone is broken off, the hollow at the heel, the protuberance at the lower and back part of the leg, and the impossibility of extending the foot, being unmistakable evidences of the nature of the accident. Upon bringing down the upper fragment in contact with the inferior, crepitus may be obtained, though it will be very faint if the tip only of the bone has been detached. The diagnosis will be more difficult when the fracture extends across the body of the calcaneum; for then there will be no displacement, the latter and interosseous ligaments keeping the posterior fragment in position. In general, however, it may be determined by the history of the case, and by making pressure upon the calcaneum in different directions, thus eliciting crepitation if fracture actually exist.

A fracture of the calcaneum from the laceration of its fibres is usually slow in *uniting* on account of the difficulty of keeping the fragments in contact, the muscles of the calf constantly tending to separate the upper from the lower. For this reason, the union will frequently, if not generally, be ligamentous instead of osseous, and a long time will, therefore, be required for the complete restoration of the functions of the foot. When the fracture is caused by direct violence, the repair is effected in the ordinary manner.

When there is much contusion of the soft parts, it may be necessary to use antiphlogistics for moderating the inflammation, before applying permanent *dressings*. The nature of these dressings must depend upon the presence or absence of displacement. In the former case, the chief obstacle to the cure is the contraction of the gastrocnemial muscles, which must, therefore, be effectually controlled until the consolidation has advanced sufficiently to enable the upper fragment to maintain its position independently of extrinsic aid. The least objectionable contrivance for fulfilling this indication is a short splint, of stout tin, well padded, and adapted to the shape of the limb, the anterior part of which it should cover from the middle of the leg as far nearly as the toes. When tin cannot be obtained, wood, sole-leather, or binder's board, may be used. The object of this splint is to maintain the leg and foot in a permanently extended position, for in proportion as this is effected will be the relaxation of the muscles of the calf. To maintain the upper fragment in place, the leg and foot may be bandaged in opposite directions, adhesive strips and a compress having previously been applied around the heel and sole. This position should be continued for at least six weeks, or until there is reason to believe that the connecting medium is firmly established. The apparatus of Petit; formerly so popular in the treatment of this form of fracture, should not be used, as it is anything but a suitable contrivance, the tendency of the cord and slipper being to displace the upper fragment, and to irritate the soft parts about the heel.

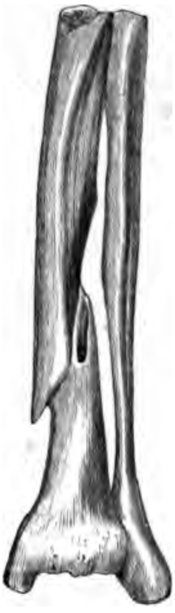
In the other variety of fracture, as there is no displacement, all that is necessary is to subdue inflammatory action, and to keep the foot and leg in a quiet and relaxed position with a tin case, or two light side splints, the limb lying upon its outer surface over a pillow.

FRACTURES OF THE TIBIA.

The tibia, like other long bones, is liable to give way at various points of its extent, but more frequently below its middle than anywhere else. A fracture of its condyles is unusual, and its occurrence is always denotive of great direct violence. Occasionally the bone is broken near its upper extremity, from an inch to an inch and a half below the knee. The internal malleolus is sometimes detached by a twist of the foot, by a fall upon the sole of the foot, or by direct injury.

Most fractures of the shaft of the tibia are oblique, very few, if any, transverse; nevertheless, as the fibula retains its integrity, there is seldom any considerable displacement, the sound bone acting as a splint to the broken one. It is not often, however, that the fragments completely retain their apposition; in general, there is some degree of separation, which may always be easily detected, even when there is considerable tumefaction, by passing the finger along the tibia, and tracing its outline. If there be a fracture, it will manifest itself by an abnormal depression at some particular point, or by an unnatural projection, sufficiently obvious to establish at once the nature of the case. The amount of this projection is often very great, especially when the upper fragment is very long, sharp, and oblique, in which event it is generally extremely prominent, and with difficulty prevented from piercing the skin. The annexed drawing, fig. 400, from a preparation in my collection, conveys a good idea of this form of injury. For the reason just mentioned, there will usually be an absence of crepitation, or if there be any evidence of this kind, it will be very faint and unsatisfactory. The fracture, if perfectly free from complication, will commonly unite in from four and a half to five weeks.

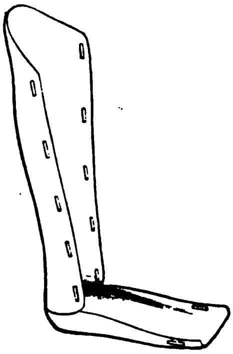
Fig. 400.



Oblique fracture of the tibia.

Fracture of the internal malleolus is met with in various forms. In some cases, the process is broken off at, or close to, its connection with the lower end of the tibia; in others, near its free extremity; but the most common site of the lesion is about the centre of the process. Its direction is nearly always oblique; rarely, if ever, strictly transverse or perpendicular. Occasionally the process is broken at several points, thus constituting a comminuted fracture. Finally, cases occur, although rarely, in which the fracture coexists with fracture of the lower extremity of the fibula. The diagnosis is easily established by the position of the foot, which is always turned upwards and inwards, as if it were partially dislocated, and by the facility with which the detached piece of bone can be moved about with the thumb and finger; a procedure which also readily elicits crepitation.

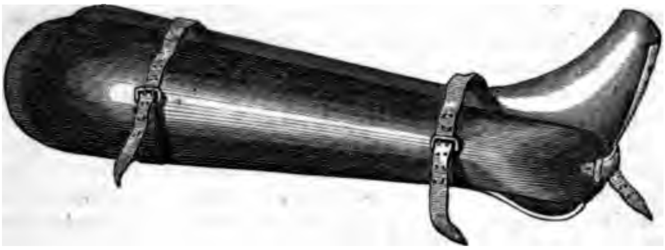
Fig. 401.



Tin case.

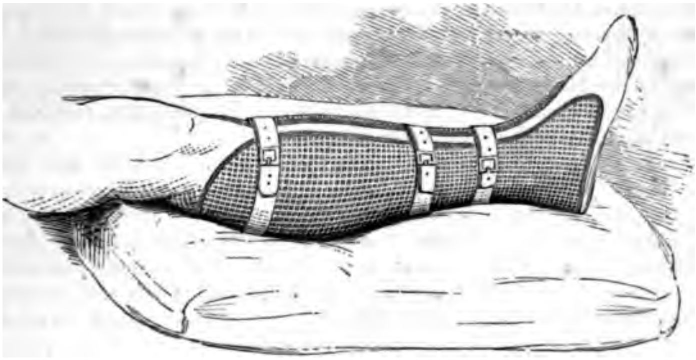
The most simple contrivance for the *treatment* of fracture of the tibia, is a tin case, fig. 401, accurately shaped to the limb, provided with a foot-piece, and reaching a few inches above the knee. A bandage is applied in the usual manner, and any tendency to displacement is easily counteracted by means of a compress, arranged so as to bear gently and equably upon the ends of the fragments. I have never found it necessary to employ any other apparatus than this, no matter where the tibia was broken. When the fracture involves the malleolus the foot-piece will effectually prevent displacement. In fracture of the superior extremity of the tibia, extending into the condyles, the plan usually adopted is to place the leg and thigh in the straight position, so as to compel the condyles of the femur to support the broken bone, extension and counter-extension being made with two long splints. Such a contrivance, however, will be altogether unnecessary, if we employ the tin case, especially if it be made sufficiently long to embrace the inferior third of the thigh, thereby completely counteracting any tendency on the part of the muscles of the limb to draw the upper fragment backwards into the popliteal space. An efficient apparatus for these fractures will also be found in Dr. Welch's splints, fig. 402; and in the wire splints of Dr. Bauer, fig. 403, the latter being particularly valuable on account of their light, airy, and pliable character.

Fig. 402.



Dr. Welch's splints.

Fig. 403.



Dr. Bauer's splints.

FRACTURES OF THE FIBULA.

Fracture of the fibula is, relatively considered, a sufficiently common occurrence, its frequency being due apparently to the slender form of this bone, to its superficial situation, and, above all, to the important part which it plays in the formation of the ankle-joint. The accident may take place at any portion of the bone, but is most common, by far, in the inferior fifth of its extent, owing to its intimate connection with the astragalus, which, constituting the pivot of the foot, readily receives and transmits the various shocks to which the latter is so continually exposed. Of fractures of the shaft and head of the fibula, no particular description is necessary, since they are always easy of detection, and since the treatment does not differ materially from that of similar injuries of the tibia. But it is different with fractures of the inferior fifth of the bone, where, as just stated, the lesion is most common, and where, from being usually associated with other mischief, it is extremely liable to be followed by deformity and permanent lameness. For these reasons, fractures in this situation require to be studied with more than ordinary care.

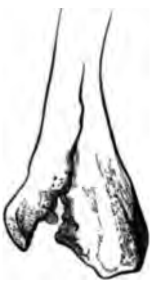
Fractures of the fibula are much more common on the right side than on the left. In 207 cases collected by Dupuytren, more than two-thirds involved the right leg. The statistics of Malgaigne show that it is most frequently met with between the ages of twenty-five and fifty, and that men are more than four times as liable to it as women. Of 104 cases examined by this author, not a single one occurred before the fifteenth year.

The *causes* of fractures of this portion of the fibula can be properly appreciated only by a careful examination of their mechanism. The tibio-tarsal articulation, being a hinge-joint, admits chiefly of flexion and extension, its lateral movements being restrained by the two malleoli, and the ligaments by which the bones of the leg are connected with those of the foot. Hence, the latter cannot be turned outwards or inwards to any considerable extent without producing a fracture of the former, the site of injury being determined by the particular inclination of the limb. Thus, when the foot is forcibly abducted, its inner edge resting on the ground, the upper surface of the calcaneum will be pressed violently against the external malleolus, in a direction parallel to the fibula, which will, consequently, yield at its weakest point, which is about an inch and a half above the joint, at the part sometimes called the neck of the bone. In most cases there is a rupture of the deltoid ligament, if not also a fracture of the internal malleolus. When the foot is forcibly adducted, the astragalus becomes the immediate cause of fracture, for this bone, turning upon its antero-posterior axis, escapes from the arched cavity formed by the tibia and fibula, and, pressing against the outer malleolus, breaks the fibula nearly at the same level as in the preceding case, the direction of the fissure being usually somewhat oblique. The external lateral ligament is either torn or violently stretched.

The most ordinary cause of this fracture is a fall upon the foot, in which this portion of the limb is forcibly inclined laterally, at the moment the weight of the body impels the bones of the leg forcibly against those of the foot, rendered stationary by the resistance offered by the ground. The fibula may also be broken across by violence applied directly to the part, as a blow, or the passage of the wheel of a carriage. Of 207 cases of this accident recorded by Dupuytren, 120 were the result of forcible adduction, and 60 of forcible abduction, the rest being caused by direct violence.

However the fracture may be induced, the superior extremity of the inferior fragment is always thrust inwards against the tibia, while the inferior extremity of the superior fragment either remains fixed, or inclines in the same direction. The latter usually happens when the injury is direct, the former when it is indirect.

Fig. 404.



Fracture of the fibula.

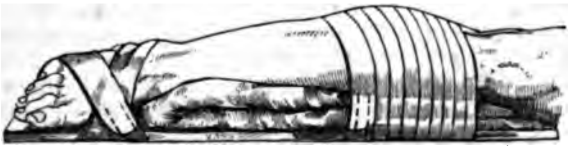
The inferior extremity of the fibula is sometimes broken almost vertically; such an occurrence, however, must be extremely uncommon, and I have seen but two instances of it, both of them being specimens in the Mütter collection. In one, represented in fig. 404, the bone looks as if it had been split, the fissure extending upwards, almost in a straight line, fully an inch and a half; the posterior, longer, and larger fragment being pushed considerably backwards, so as to form with the other an intermediate triangular space. In the other bone the fracture is also vertical, but the separation is much less.

The *symptoms* of fracture of the lower extremity of the fibula vary according to the circumstances of the case. When this bone alone is severed, the chief signs will be slight eversion of the foot, a depression at the site of injury, and some change, usually not very conspicuous, in the contour of the ankle-joint. When the internal malleolus is broken off, or when the tibia has given way a short distance above the articulation, these characters will exist in a more marked degree, and point out unerringly the nature of the lesion. The foot will be so much abducted as to present the appearance of being dislocated outwardly; the width between the two malleoli will be much increased; the hollow at the line of fracture will be quite deep; and the external margin of the foot will be considerably elevated, while the internal will be proportionately depressed. Upon taking hold of the foot, it will be found that it is unusually movable, and that it can easily be restored to its natural relations, but that the moment we cease our grasp it will return to its former position. In performing these manipulations crepitus is very easily felt; and, upon tracing the outline of the lower portion of the bone, the finger will usually sink in at the seat of fracture, owing to the fact, previously mentioned, that the upper end of the lower fragment always falls over towards the tibia. A good deal of ecchymosis is often present, and a considerable amount of swelling quickly follows, obscuring the characteristic features of the injury, and embarrassing the diagnosis. The only accident with which fracture of the inferior extremity of the fibula is liable to be confounded is a sprain of the ankle-joint, from which, however, it may always readily be distinguished by the great distortion which attends it, and by the presence of crepitus.

A simple fracture of the fibula in the inferior fifth of its extent will, if properly treated, usually unite in a month, without any deformity of the limb, although even then a considerable time will elapse before the ankle-joint will perfectly regain its functions. When the injury is complicated with rupture of the ligaments, fracture of the corresponding portion of the tibia, or other serious lesion, the repair will be much slower, and there will be danger, unless the case is managed with the most consummate skill, of permanent deformity and lameness, the former manifesting itself in an everted condition of the foot and in increased width of the ankle-joint.

The material point in the *treatment* of fracture of the fibula in this situation is to maintain the foot in a position the reverse of that which it assumes in consequence of the injury. To accomplish this object, which is designed to draw away the upper extremity of the lower fragment from the tibia, and to restore it to its proper relations, the limb, after having been enveloped in the ordinary bandage, with the precaution of not compressing it opposite the site of fracture, is placed in a tin case, the foot being directed permanently inwards. The requisite inclination may easily be imparted by means of a piece of roller, or a few adhesive strips, carried around the instep and heel, and attached to the inside of the leg. Or, instead of this, the fracture may be treated with Dupuytren's apparatus, fig. 405, consisting of a light wooden splint and a wedge-shaped cushion; the former reaching from the upper third of the leg to about three inches below the sole of the foot, and the latter from

Fig. 405.



Dupuytren's apparatus.

the same point to a level with the ankle. The limb being bandaged in the same cautious manner as in the former case, the apparatus is stretched along its inner surface with the tapering end of the pad upwards, and secured, first above, and then below, the roller being passed around the foot and ankle in such a manner as to turn the internal margin of the foot upwards and inwards. The limb may afterwards be kept in the extended position, or, what is preferable, be placed, half bent, upon its outer surface over a large pillow. The parts are diligently watched, the dressing being changed as occasion may seem to require, and passive motion instituted at the end of the third week.

FRACTURES OF BOTH THE TIBIA AND FIBULA.

Fractures of both bones of the leg are sufficiently common, particularly in young and middle-aged subjects, and are deserving of special attention, on account of the difficulty of their management, and their liability to be followed by deformity and lameness.

Much diversity obtains in regard to the *seat* of these fractures, as well as concerning their direction, and the nature and extent of their displacement. In twenty-two specimens, contained in Dr. Mütter's collection and my own, I find that in ten the tibia and fibula were broken at their inferior extremity, the line of separation in none of them extending beyond three inches above the joint. In four the tibia gave way at its lower third, and the fibula at from two to three inches and a half from its head, or junction with the upper end of the tibia. In six of the cases the tibia was broken from two to three inches above its inferior articulating surface; in two of these the fibula had yielded at its middle, and in the remaining four at different points of its extent. In only two cases had both bones been broken at the same level; in one of these the fracture occurred at the middle of these pieces, and in the other a little below that place.

In the twenty-two cases the tibia had been broken only twice above its middle; whereas, the fibula had given way above this situation in six cases. In sixteen of the cases the seat of fracture of the tibia was either at the ankle-joint, or below the middle of the bone, generally in its inferior fourth or third. In ten cases of fracture of the fibula the seat of the injury was either at the joint, or within the first three inches from its articulating extremity.

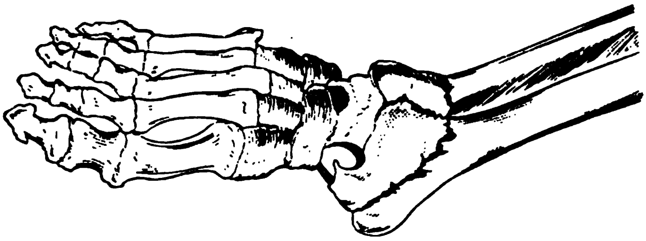
From the above examinations it follows: first, that the tibia and fibula rarely break on the same level; secondly, that both bones are most liable to yield either at the ankle-joint, or, at all events, within the first three inches above that joint; and thirdly, that the fibula is more frequently fractured at its superior extremity than the tibia.

An examination of these specimens has supplied me with some other interesting facts. Thus, I have found that the fracture in nearly all was more or less oblique, the line of separation in fifteen specimens of broken tibia extending from above downwards, and from without inwards. As a natural consequence of this occurrence, the superior extremity of the inferior fragment projected outwards towards the fibula, which it touched in several of the preparations, on account of a want of proper adjustment during the treatment; the lower extremity of the upper fragment, on the contrary, projected inwards, and had apparently generally been much the sharper of the two. The fibula, in most of the specimens, afforded evidence of having been broken across more abruptly than the tibia, but still with a considerable degree of obliquity in almost every instance that I inspected.

In recent fracture of the tibia, complicated with fracture of the fibula, the inferior extremity of the upper fragment is generally remarkably sharp, and, in consequence, often protrudes through the integuments at the time of the injury, the same cause that produces the lesion forcing it across the soft parts. Or, if it is not pushed out at the moment of the accident, it often escapes afterwards, through ulceration, induced by the pressure which it exerts upon the soft parts. The obliquity of fractures of the tibia is often very extraordinary, and there are few cases in which it does not become a source of great suffering to the patient, and of annoyance to the surgeon, on account of the trouble that is experienced in keeping the fragments in their proper relations.

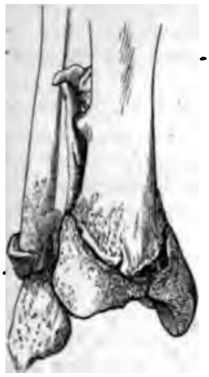
A rare form of fracture of these two bones is represented in fig. 406, from a specimen in my collection. The tibia, it will be perceived, is broken off just above its articulating surface without affecting the internal malleolus, while the fibula has given way about an inch and a quarter above the joint. The foot is characteristically everted. In fig. 407, also from a specimen in my possession, the fracture embraces both the extremity and the malleolus of the tibia; the fibula being broken off a few lines above the joint. Fig. 408 exhibits the appearance of the broken articulating surface of the tibia.

Fig. 406.



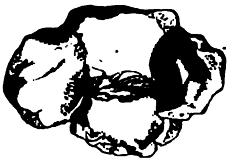
Fracture of the tibia and fibula at the ankle-joint.

Fig. 407.



Fracture of the bones of the leg at the ankle-joint.

Fig. 408.



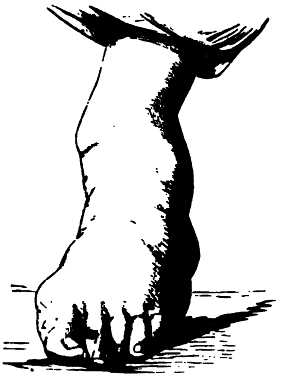
Broken articulating surface of the tibia.

The *causes* of fractures of both bones of the leg are either direct or indirect, just as when these pieces suffer separately. A very common mode in which the accident happens is a fall upon the pavement, as when an individual slips in consequence of the presence of ice, or when, as he is rapidly walking, the foot is suddenly caught in a hollow, or between two hard resisting objects, so as to throw the whole weight of the body upon the leg. Another way in which the lesion is produced is a fall from a considerable height, as when a person is precipitated from a scaffolding. Jumping out of a carriage under full speed often produces fracture of the tibia and fibula. In many cases, the injury is occasioned by direct violence, as by the passage of the wheel of a carriage, the kick of a horse, the caving in of a sand bank, or the fall of a heavy stone.

The *symptoms* of the injury, however induced, are generally well marked, if not positively unmistakable. In nearly every case the limb is shortened from one and a half to three inches, and there is also, generally, great deformity in its diameter, both depending upon the overlapping of the fragments, which, as already stated, is frequently very extraordinary. Besides, upon making extension and counter-extension, it is generally easy to elicit crepitation. When the fracture is very oblique, the lower end of the superior fragment may usually be felt immediately beneath the integuments, forming a sharp, prominent projection in front of the limb, or at its inner aspect. Sometimes the soft structures are much bruised and ecchymosed. Another remarkable symptom, one which, indeed, is seldom absent, is a spasmodic twitching of the limb, coming on soon after the accident, and frequently lasting for several weeks, much to the annoyance and distress of the patient.

When the fracture is situated just above the ankle, the foot will usually be a good deal everted, causing an appearance of dislocation outwards, as exhibited in fig. 409.

Fig. 409.



Fracture of the lower end of the tibia and fibula.

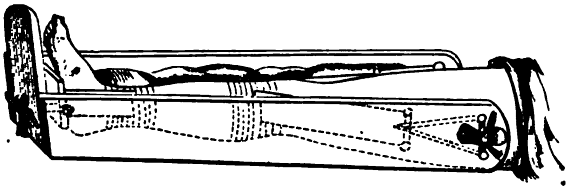
The *prognosis* of fracture of both bones of the leg may be gathered, in part, from what precedes. In the more simple forms of the injury, attended with but little obliquity, a good cure can generally be effected in from four to five weeks. If, however, the obliquity is uncommonly great, it will be found extremely difficult, if not impossible, to effect consolidation in a manner altogether unexceptionable, however skilfully and zealously the treatment may be conducted. More or less deformity will almost be inevitable, either in the length or in the diameter of the limb; owing to the remarkable tendency which the ends of the fragments have to overlap each other, and which it is often impossible to counteract successfully, whatever means may be adopted for the purpose.

Old fractures of the tibia and fibula, like those of the bones of the forearm, are occasionally connected by a bridge of callus, or of new osseous matter, which does not, however, so far as can be determined, impair their usefulness, as must always necessarily be the case with the latter. I have several times met with this occurrence when the lesion was confined to one of these bones, and I am not able to say whether one is more liable to give rise to it than the other. Moreover, it does not seem to be necessary to its production that there should be any approximation of the ends of the opposite fragments, as it may take place when they are perfectly straight, although the former condition no doubt acts as a predisposing cause.

Fractures of both bones of the leg, if attended with shortening of the limb, require to be treated by extension and counter-extension, steadily and persistently maintained throughout, otherwise, as just stated, deformity will almost be inevitable. If, on the other hand, the fracture be transverse, or nearly so, such a procedure may of course be dispensed with, the object being attained by confining the leg in a tin case, or fracture box, care being taken to keep the great toe constantly on a line with the inner border of the patella, the surest evidence that there is no rotation of the ends of the fragments upon each other. Any tendency to forward, backward, or lateral displacement is generally easily counteracted by means of compresses and short splints. The limb may then be placed in an easy position upon a slightly inclined plane, made of a bolster or pillow, or it may be suspended by a cord and pulley to the tester of the bed, as may be found most agreeable or convenient.

Counter-extension may be made when the fracture is oblique, by means of a box provided with a foot-board, and two lateral splints, one extending to the perineum, and the other to the axilla, as I have generally myself preferred; or with the contrivance of Dr. Neill, consisting of a box, reaching as high as the middle of the thigh, the counter-extension being made with adhesive strips, passed through holes at the upper part of the apparatus, and tied on the outside, as exhibited in fig. 410.

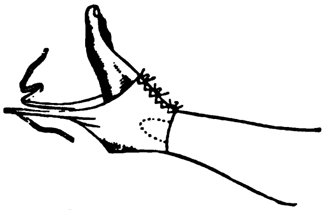
Fig. 410.



Dr. Neill's apparatus for fracture of the leg.

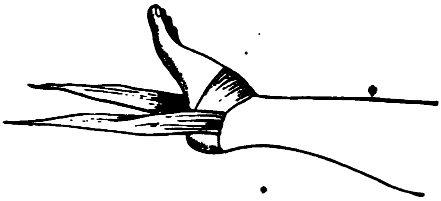
The use of the gaiter, fig. 411, in the treatment of fractures of the leg and thigh, attended with shortening and deformity, cannot be too pointedly condemned, as it is almost impossible, in any case, however carefully watched, to prevent chafing, and other inconvenience. A similar remark is applicable, only more forcibly, to the handkerchief, fig. 412, at one time so much employed for this purpose. Both appliances are most villainous, and should therefore be proscribed, especially as an admirable substitute may always be found in the adhesive strips, secured to the sides of the limb, fig. 413, and tied at the bottom of the foot-board.

Fig. 411.



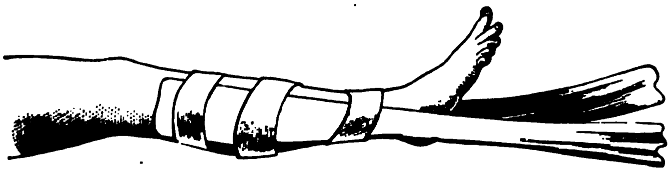
Application of the gaiter.

Fig. 412.



Application of the handkerchief.

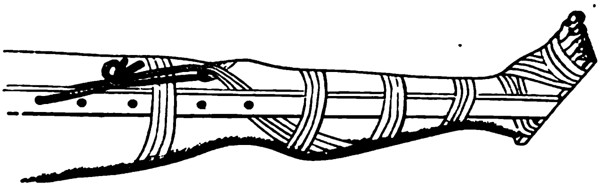
Fig. 413.



Application of adhesive strips for making extension.

The annexed cut, fig. 414, represents the method of treating oblique fractures of the leg, recommended by Dr. Swinburne. A narrow, delicate splint and foot piece are fastened by means of adhesive plaster, while counter-extension is made from the knee by strips of the same material looped about the limb below the joint. A strong cord is then passed through this loop, and thence on through a hole in the side splint, opposite the lower part of the thigh, in order to afford the requisite degree of tension. If, after the apparatus has been applied, the limb is not sufficiently steady, adhesive strips must be used, as represented in the engraving.

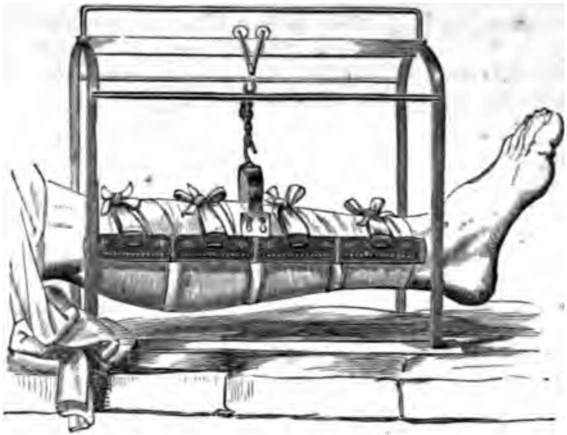
Fig. 414.



Dr. Swinburne's mode of treating fracture of the leg.

Suspension of the leg may sometimes be advantageously practised, both as it respects the comfort of the patient and the welfare of the fracture. It may be done according to the method recommended, many years ago, by Professor N. R. Smith, of Baltimore, or the very simple contrivance of Mr. Salter, of England, depicted in fig. 415, representing the limb surrounded by the apparatus and slung to the tester of the bed. The case in which the leg rests is made of light metal; and the whole contrivance is so arranged as to admit of lateral motion, and also of sliding up and down, simply by the rolling of the pulley-wheels upon the horizontal bar.

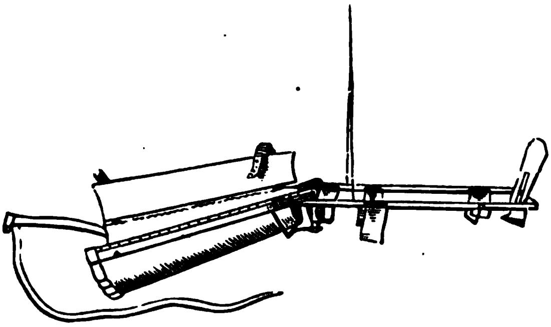
Fig. 415.



Salter's apparatus for suspending the leg.

The apparatus of Dr. Smith may be used for fractures of any of the long bones of the lower extremity, whether simple, compound, or complicated. It consists, as is seen in fig. 416, of two pieces, united by a hinge, after the fashion of a double inclined plane, one corresponding with the thigh, and the other with the leg, the latter supporting a shoe, which is attached by a thumb-screw, and is so arranged as to be rotated outwards or inwards, thereby elevating or depressing the toe, as may be deemed most desirable. The two pieces are supplied with side boards, joined by bows of iron beneath; and they are so constructed, both at the knee and at the foot, that they may be elongated or shortened at pleasure. Moreover, a short crutch, movable and well padded, is secured to the inner and upper extremity of the thigh portion, in order to prevent injurious pressure upon the perineum. Another piece, well padded, movable, and composed of iron, is appended to the superior and outer part of the apparatus, and is fastened round the trunk by a strong band. The thigh and leg rest on slings attached to the side-pieces, the latter being confined in the apparatus by its own weight, aided by a bandage, while the former is supported in front by a well padded, flexible splint. The whole contrivance is suspended to the ceiling, or the tester of the bed, by a single cord, attached below the knee, near the centre of gravity of the limb and apparatus. The cord ascends with a slight obliquity from the trunk, so as to effect the requisite extension, by making gentle traction on the limb, which is completely grasped by the apparatus, and consequently firmly held by it. In this manner, the member is compelled to obey all the accidental and necessary movements of the body, thus obviating all strain and tension at the seat of fracture.

Fig. 416.

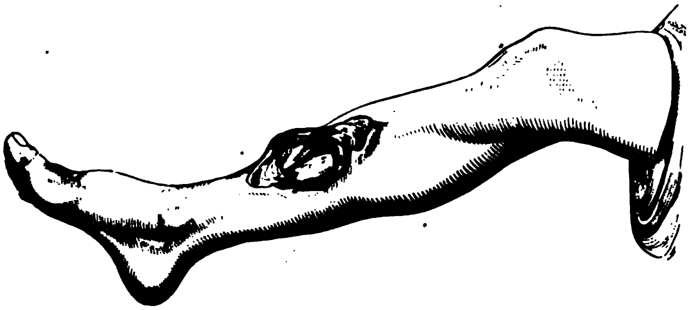


Dr. N. R. Smith's suspending apparatus or double inclined plane.

COMPLICATED FRACTURES OF THE LEG.

Fractures of the leg are not unfrequently complicated, whether involving both bones or only one, as in fig. 417. In the latter case, the tibia, much more frequently than the fibula, is the piece that is most liable to suffer. Such accidents are produced in various ways; sometimes by violence applied to the foot, as when a man jumps out of a second story window, or falls from a scaffolding; but more generally by direct force, as the passage of the wheel of a carriage, a blow from a stone, or the kick of a horse. When produced

Fig. 417.



Complicated fracture of the leg.

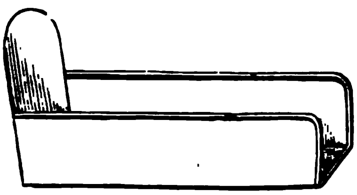
by these and other similar causes, the lesion is usually situated in the inferior portion of the leg, towards the ankle-joint, which is not unfrequently penetrated. Fractures of the leg, occasioned by railway violence, are always of a comminuted character, the bones being extensively crushed, and the soft parts severely lacerated and contused, if not actually pulpified. Hemorrhage, both venous and arterial, often sadly complicates such injuries, and, along with the shock, sometimes proves speedily fatal, the system, perhaps, never fairly reacting after the accident. Complicated fractures of the leg, of a very bad character, are also frequently produced by machinery in rapid motion, and by gunshot violence. Sometimes, again, especially when there is unusual brittleness of the osseous tissue, the bones are frightfully broken by causes so trivial as to surprise us how they could have induced such a result.

In whatever manner complicated fractures of the leg may happen, the ends of the fragments, particularly those of the tibia, are extremely liable to protrude at the wound; the latter often in such a manner as to render it very difficult to effect replacement, owing to its being tightly girt by the edges of the opening in the integuments, and also to the great length which so frequently distinguishes it. The symptoms of such accidents are always sufficiently characteristic, since there is usually not only great deformity, but likewise, as just stated, exposure of the ends of the broken pieces. Nevertheless, although no difficulty can attend the diagnosis, under such circumstances, so far as the existence of fracture is concerned, yet the surgeon should always institute a most careful and searching examination, with a view of ascertaining the real condition of the soft structures, the welfare of which is often much more deeply interested than that of the bones themselves. The first object, in every case of the kind, should be to determine what should be done; whether an attempt should be made to save the limb or to cut it off. As a general rule, it may be stated that when—if I may use an antithetical and apparently contradictory expression—the complicated fracture is simple, that is, without any serious lesion of the soft parts, an effort should always be made to preserve the limb, especially if the patient be young and robust, and the bone not comminuted, although perhaps broken at several different points. It is true, such cases sometimes terminate unfavorably, both as it respects limb and life; and it should also be borne in mind that the injury sustained both by the soft and the osseous tissues may be much greater and more serious than the eye and hand can possibly detect. The dangers, too, from tetanus, pyemia, erysipelas, secondary hemorrhage, and profuse and exhausting suppuration, are not to be overlooked by the surgeon in his laudable endeavors to save a patient from mutilation; nor is he to forget that such lesions, especially when seated near the ankle-joint, are extremely liable to be followed by anchylosis.

When the bones are severely comminuted, the soft parts terribly lacerated, or the ankle-joint extensively opened—in short, when the limb has been frightfully bruised, torn, and crushed—no one would hesitate to use the knife the moment sufficient reaction has taken place to enable the system to withstand the additional shock. The case even then is frequently a bad one, the patient often rapidly sinking from exhaustion, or soon after from the effects of pyemia.

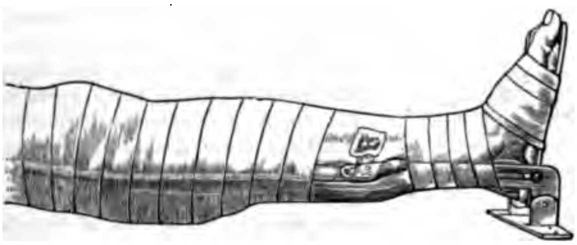
When an attempt is made to preserve the limb, the first indication is to arrest hemorrhage; the second, to coaptate the ends of the broken bone; the third, to place the limb in an easy, comfortable, retentive apparatus; and the fourth, to moderate the resulting inflammation. These intentions are to be fulfilled in conformity with the general principles laid down under the head of general observations on fractures. If the ends of the fragments are unusually long and sharp, and disposed to protrude despite of the ordinary precautions, the best plan will be to retrench them; being careful, however, to cut off as little as possible. The edges of the wound are accurately approximated by suture and collodion, every precaution being used to exclude the atmosphere. The best fracture apparatus is the wooden box, fig. 418, so much used in this city, both in private and hospital practice, consisting of four pieces, one corresponding with the back of the leg, and two with its sides, the fourth being intended for the foot. The latter, projecting nearly perpendicularly, is provided with two mortise holes, for the reception of the extending bands. The two lateral pieces are secured each by two hinges to the back board, so as to admit of being opened or shut at pleasure during the application and removal of the dressings. The limb, enveloped in the bandage of Scultetus, is carefully laid into the box, previously closed, and partially filled with coarse bran, which is afterwards piled on until the whole leg and the spaces on each side of it are completely covered in. The advantage of the bran, thus used, is that it affords not only easy, equable, and comfortable support to the broken bones, but also that it readily absorbs the discharges, and prevents the deposit of the ova of the fly, so common during the hot months of this and other countries. Substitution is effected whenever the substance becomes soiled and caked. For a knowledge of this mode of treating compound fractures of the leg, the profession is indebted to Dr. John Rhea Barton, and there is no question that it is one of the most valuable improvements that have been introduced into the management of this class of injuries at the present day, whether it be viewed merely with reference to the comfort of the patient, the safety of the limb, or the convenience of the surgeon.

Fig. 418.



Fracture-box.

Fig. 419.



Compound fracture of the leg, dressed.

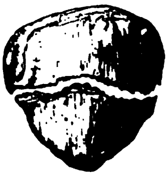
The necessary extension and counter-extension are easily effected by adhesive strips. For the first week or ten days, leeches and cold water-dressing will generally be required. Should suppuration arise, the most soothing application will be a linseed poultice.

A very common mode of dressing compound fractures of the tibia alone is by M'Intyre's screw splint, represented in fig. 419, well padded, and extended; an opening being left in the bandage opposite the wound.

FRACTURES OF THE PATELLA.

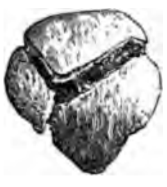
Fracture of the patella, figs. 420 and 421, although comparatively an uncommon event, is of great practical importance, from its proximity to the knee-joint, and the imperfect manner in which it is usually repaired. It may extend through the bone in any direction, transversely, obliquely, or vertically, the frequency of the occurrence being in the order here stated. When the fracture is comminuted, the fissures often exhibit the most irregular arrangement.

Fig. 420.



Transverse fracture of the patella.

Fig. 421.

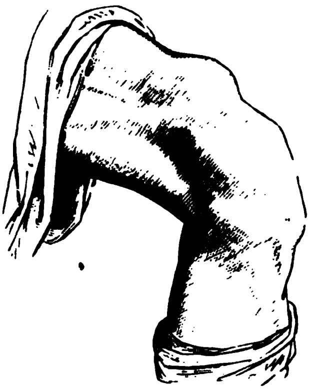


Oblique fracture of the patella.

The *causes* of the accident are two, external violence, and muscular action. The transverse fracture is nearly always produced by the latter, or by the joint agency of the two, while the oblique and vertical are invariably the result of direct injury, as a fall, blow, or kick. In the latter case, consequently, there is frequently severe contusion of the soft parts, and sometimes the knee-joint is even laid open. The transverse fracture is produced by falls in which the leg is strongly flexed upon the thigh, while the body is thrown suddenly and forcibly backwards, thereby putting the extensor muscles powerfully upon the stretch, the line of fracture usually taking place just above the middle of the bone. Jumping out of a carriage, and falling backwards upon the ground, is one of the most common ways in which the accident is occasioned. Circus-riders and ballet-dancers sometimes break this bone in the act of leaping in the exercise of their profession.

The *symptoms* of fracture of the patella are generally well marked. In the transverse form of the lesion, the nature of the accident is at once detectable by the change in the contour of the knee, by the inability to extend the limb, and by the displacement of the upper fragment, as seen in fig. 422. In many cases, the person is conscious, at the moment of the injury, of something having given way, and perhaps he may have even heard the peculiar characteristic snap. If he attempts to get up and walk, he will be almost sure to fall, from his inability to extend the leg and support the weight of the body upon it. The displacement is usually considerable, the superior fragment being drawn upwards upon the fore part of the thigh by the extensor muscles. The height to which it may be carried varies according to the extent of the destruction of the ligamentous connection of the tendon of these muscles. When the separation is complete, it may amount to two and a half, three, and even four inches, while under opposite circumstances it may not exceed six, eight, or ten lines. The distance between the two fragments is always increased by bending the leg. The front of the knee has a flattened appearance, and upon passing the finger over it its point will be found to sink down abruptly as it were into the joint. The lower fragment is stationary, but the upper is easily moved, and may, by thorough extension of the limb, be brought down into its normal situation, so as to enable us to detect crepitus. If some time has elapsed since the occurrence of the accident, considerable swelling may be present, obscuring somewhat the diagnosis.

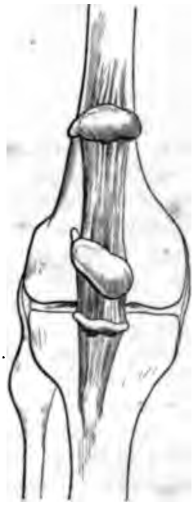
Fig. 422.



Fracture of the patella.

In respect to its mode of *union*, the transverse fracture of the patella holds the same relation as a similar injury of the olecranon. In both cases the nutrition of the fragments is seriously impaired by the laceration of the vessels, and in both great difficulty is experienced in maintaining coaptation. Hence it is a law that the union takes place by ligament and not by bone. In all the cases of this fracture that I have been able to examine, both in the living subject and in museums, I have not met with any in which the consolidation was completely osseous. A few such cases, however, have been described by surgeons. In the inferior animals, it is not uncommon, if care be taken to keep the ends of the bone accurately in contact. When the interval between the broken pieces is very considerable, as, for example, when it amounts to two inches, the union is established by the aponeurotic tissue which naturally covers the patella, and which, in this case, extends from one fragment to the other, the plastic matter which is poured out in consequence of the injury not being capable of becoming organized and converted into ligamentous matter. Whatever may be the nature of the connecting medium, it is important that it should be as close and perfect as possible; for it is found that the joint will always be weak and unprotected precisely in proportion to its length and thinness.

Fig. 423.



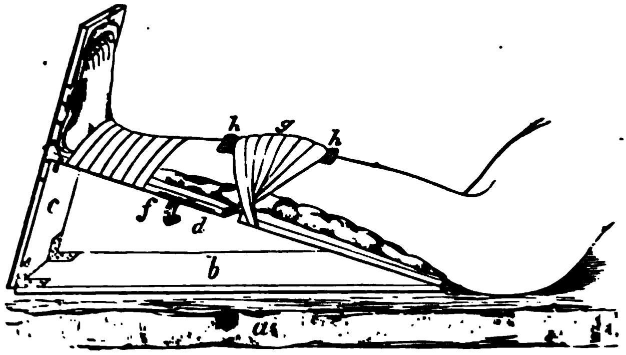
Old fracture of the patella, showing the separation of the fragments.

The annexed cut, fig. 423, represents a sketch from a specimen of fracture of this bone in the cabinet of Professor Pancoast. It will be seen that the patella is broken into three pieces, the superior one being drawn up in front of the thigh, far away from the joint, and nearly four inches from the inferior, which consists of a mere little strip, hardly two lines in width, corresponding with the lower edge of the bone. No union followed, owing, doubtless, to bad management or neglect, and the consequence must have been a very imperfect use of the limb.

The *treatment* of transverse fracture of the patella is attended with serious difficulty on account of the trouble experienced in controlling the action of the extensor muscles, whose tendency is constantly to draw the superior fragment upwards away from the lower. To counteract this tendency, therefore, constitutes the chief indication of the treatment. This can be effected only by maintaining the leg steadily and faithfully in a complete state of extension, the thigh being at the same time flexed upon the pelvis, and the body kept in the semi-erect posture. In this manner, the extensor muscles are thoroughly and effectually relaxed. The most efficient contrivance for insuring this position of the limb is a strong, well padded tin case, long enough to reach from the middle of the thigh, to the corresponding point of the leg, a roller having previously been applied from the toes upwards, and another from the groin downwards. The superior fragment, having been brought into place, is next confined by numerous adhesive strips, carried around the bone above and below the joint, and connected afterwards by vertical and transverse pieces. The dressing is completed by the application of a long, thick, and rather narrow compress, extended around the upper border of the patella, and confined by the two rollers passed around the joint in the form of the figure 8. Managed in this way, it is hardly possible for the fracture to suffer the slightest displacement, or to conceive of anything better calculated to fulfil the end in view. The tin case maintains the limb in the extended position, the adhesive strips and compress retain the upper fragment in contact with the lower, and the two rollers, applied in opposite directions, aid powerfully in controlling muscular contraction.

When a suitable case cannot be procured, the object may be attained by the use of a wooden splint, well padded, and stretched along the posterior part of the thigh and leg. The adjoining drawing, fig. 424, represents the mode of dressing transverse fractures of the patella, pursued by Professor Hamilton, and also, with slight modifications, at the Pennsylvania Hospital.

Fig. 424.



Apparatus for fracture of the patella.

The plan is an excellent one, and seldom fails to effect a good cure; often with hardly any interspace between the ends of the fragments. The letters require brief explanation: *a* is the bed; *b*, floor of the splint; *c*, foot-piece, provided with holes and side-pins; *d*, inclined plane, constructed so that it may be raised or lowered at pleasure; *e*, cushion, thicker under the knee than at either end; *f*, roller, not completely applied, to secure the limb to the inclined plane; *g*, adhesive strips, laid over a compress, and crossed under the splint, those from above passing through a notch in the board behind the knee; *h*, *h*, ends of the compress.

As anchylosis is one of the occurrences most to be dreaded after this fracture, passive motion should be employed as soon as there is reason to believe that the union is sufficiently advanced to admit of it. This will usually be by the end of the third week. It should afterwards be repeated, at first every other day, and then every day, until all risk of this accident is passed. The limb must not be used for the ordinary purposes of progression for three or four months, experience having shown that, if it be exercised too early, the connecting bond will become gradually more and more elongated, and thus materially interfere with the restoration of the functions of the joint. At the expiration of four weeks, the tin case may be taken off, and a leather splint substituted, the patient walking about upon crutches.

A portion of the patella may be broken off obliquely, and, suffering no material displacement, may readily unite by bony matter, as any other fracture. A similar result generally follows when the fissure is vertical, with little or no separation of the fragments, the tendency to which is very slight, as the broken pieces are not influenced by muscular contraction. The prognosis is, therefore, other things being equal, always favorable, although, owing to the proximity of the knee-joint, a considerable period will usually elapse before there will be perfect restoration of the functions of the limb.

The signs of these fractures are sometimes very obscure, especially if there be much swelling of the soft parts. In general, however, the nature of the case may be determined by the impaired motion of the knee-joint, by the fixed character of the pain, and by making pressure upon the patella in opposite directions.

The limb, having been enveloped in a bandage, should be kept at rest in an elevated and extended position until there is a complete subsidence of inflammation, when the starch dressing should be applied, the patient being permitted to move about upon crutches. If the fracture be vertical, or nearly so, it will be necessary to support the fragments by means of two compresses, stretched along the lateral borders of the bone, and confined by adhesive strips and a roller. When the fissure is very oblique, the displacement may be such as to demand a course of treatment similar to that necessary in a transverse fracture.

When the patella has once been broken transversely, it is exceedingly liable to a recurrence of the accident from comparatively slight muscular contraction. The judicious practitioner should, therefore, always put the patient upon his guard in this respect. The fracture may occur at the same point, but generally it takes place a little higher up. Finally, when one patella has been broken, the other is apt to suffer in the same manner, owing to the imperfect use of the affected limb, and the consequent liability of the patient to fall.

FRACTURES OF THE FEMUR.

Fractures of the femur deserve the most attentive study; for not only are they of frequent occurrence but they present themselves under every possible variety of form, and there are no injuries of the kind which, to use the language of Pott, "so often lame the patient and disgrace the surgeon." Any portion of the bone may give way, and hence it is customary, in treating of the subject, to speak of fractures of the shaft of the femur, of its condyles, and of its superior extremity, or of its neck, and of its trochanters.

1. FRACTURES OF THE SHAFT.

The shaft of the femur may be broken in any portion of its extent, but there are three points which are particularly obnoxious to fracture. These points are the upper fourth of the bone, the middle, and the inferior fourth, the relative frequency of the accident being in the order here stated, although it is generally asserted that the bone yields more frequently at or near its middle than anywhere else. This idea, however, accords neither with the results of my observations upon the living subject, nor with my examinations of specimens of fractured bones in different collections. The relative difference, however, is, no doubt, very slight. A brief account of the lesion, as it occurs at these several points, will suffice to place the subject in a proper practical light, and serve to prevent those sad mistakes, often so disastrous both to the patient and the attendant.

Fractures of the Upper Fourth of the Shaft.—The most common site of fracture of this portion of the bone is from two and a half to three inches and a half below the small trochanter; the line of fracture is almost always oblique, extending from behind forwards, and from above downwards, being frequently from an inch and a half to two inches in length. A transverse fracture here is an exceedingly rare occurrence. It is also very uncommon to see the bone give way just below the small trochanter, and it is worthy of note that, when it does break at this point, it is generally complicated in its character, or associated with extra-capsular fracture, properly so termed.

The *symptoms* of fracture seated in this portion of the femur are generally so obvious as to indicate at once the nature of the injury, the characteristic signs consisting of great shortening and angular deformity. The shortening varies from two to four inches, and usually exists in full force immediately after the receipt of the injury. The superior portion of the limb is remarkably distorted, being convex on its external surface, with a corresponding concavity internally, occasioned by the overlapping of the ends of the broken bone, the upper nearly always lying in front of the lower, and both being usually directed somewhat outwards. In ten specimens of fracture of the upper fourth of the shaft of the femur, now before me, I find that in all, except one, the upper fragment is in front of the lower, the reverse being the case in the other. In these ten specimens the superior piece is drawn forwards and outwards in six; in two it is tilted upwards and inwards; and in two it is raised up and in a straight line with the lower, or without any lateral deviation whatever. The distance of the fracture from the small trochanter ranges from two inches and two-thirds to three inches and a quarter.

In the six specimens in which the superior fragment is directed forwards and outwards, the lower fragment is also inclined outwards in four, the junction between them being such as to give the bone more or less of an arched appearance, the convexity being external and the concavity internal. In the two specimens in which the upper end is directed forwards and inwards, the lower end, in one, is inclined inwards also, and in the other it is straight, or in a line with the superior fragment. In seven of the eight specimens in which the displacement is lateral, the inferior fragment is more or less strongly everted, and, consequently, the knee and foot, during life, must have been in the same position.

The fractures, so far as can be determined, were all oblique, the line of disjunction, in nine, extending from behind forwards, and from above downwards, one only being in the opposite direction, and in this the lower fragment lies in front of the upper, overlapping it four inches. The distance at which the ends of the bone are separated anteriorly, varies from half an inch to an inch and three-quarters. The angle which the superior fragment forms with the inferior, does not, in any of the ten specimens, exceed 45°, while in most it falls considerably short of this.

I have been thus particular in giving the results of these examinations, on account of their practical bearing upon fractures of the superior extremity of the shaft of this bone. Sir Astley Cooper, and those who have adopted his views, have evidently formed very erroneous ideas, not only as regards the extent and direction of the displacement of the upper fragment, but also of its causes. Thus it has been asserted that the upper end often overlaps the other almost at a right angle, which is not the case in any of the specimens that I have examined; on the other hand, it has been alleged that the two pieces are usually inclined outwards, which the specimens alluded to also disprove, there being no lateral deviation whatever in two, while in two others the projection was inward, leaving thus only six cases of outward displacement. The displacement forwards of the upper end is due to the joint action of the psoas and iliac muscles, assisted perhaps by the pectineal and the short head of the adductor, while it is dragged outwards mainly by the agency of the external rotators. The lower fragment, on the contrary, is drawn up by the action of the flexor muscles of the thigh, and outwards by the tensor, vastus, and gluteal muscles. That the direction of the fracture materially influences the direction of the displacement is shown by the fact that in the only specimen out of the ten examined by me in which the line of fracture extended from before backwards, and from below upwards, the lower fragment overlapped the upper, and that to a great extent.

Although the specimens here described are, I conceive, of great pathological and practical value, yet it must not be forgotten that any inferences deducible from their examination are impaired, in some degree, by the fact that the displacement which characterizes them may have been influenced more or less by the nature of the treatment. Thus, in consequence of the use of splints, the ends of the fragments, originally inclined inwards or outwards, may have been pushed and held in the opposite direction, thereby completely reversing the primitive order of the deformity, as caused by the direction of the fracture, the weight of the limb, and the action of the muscles.

The annexed drawings, two of which are from my own preparations, will serve to illustrate the nature of the displacement so often met with in fractures of the superior portion of the shaft of the femur.

Fig. 425.

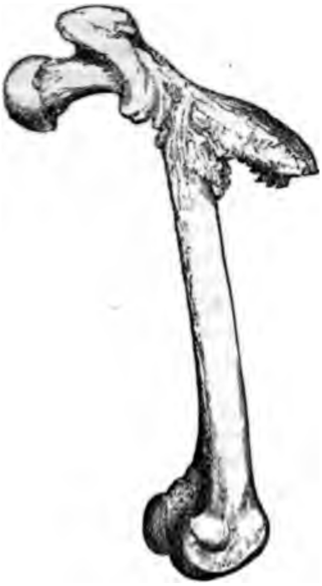


Fig. 426.

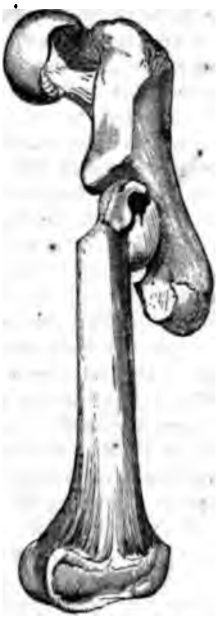
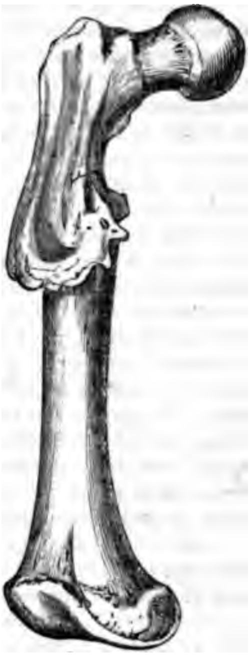


Fig. 427.



Fracture of the shaft of the femur; upper portion.

Fractures at the Middle of the Shaft.—A fracture at the centre of the shaft of the femur is, according to my observation, an uncommon occurrence; most generally the bone gives way some distance above or below this point. The line of fracture is, for the most part, very oblique, extending from behind forwards and from above downwards, and the consequence is that the superior fragment nearly always overlaps the inferior, the upper extremity of which is drawn backwards, and usually, also, somewhat outwards, by the action of the flexor muscles, causing thus an amount of shortening of from two and a half to three and even four inches, with more or less angularity at the site of injury, and marked eversion of the limb. The lower end of the superior fragment, on the contrary, forms a prominent projection on the fore part of the thigh, easily perceived by sight and touch. The symptoms are of course characteristic.

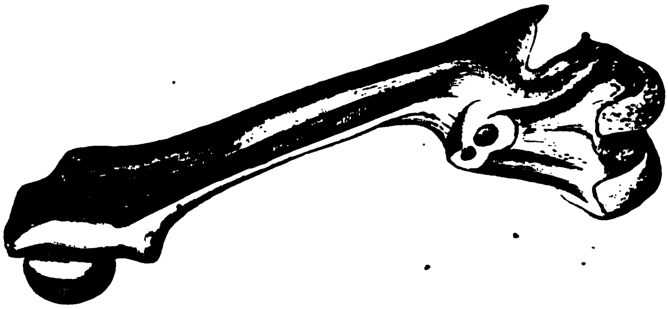
A perfectly horizontal fracture of the shaft of the femur is an extremely uncommon occurrence; so much so that, although the phenomena might be such as to lead to the suspicion of its existence, the idea that it really is an injury of that kind should not be carried out in practice, lest, the requisite extension and counter-extension being omitted, permanent shortening should follow. When there is no marked tendency to displacement, it will generally be found that the fracture, instead of being transverse, is slightly impacted, or that its extremities, being denticulated, are interlocked with each other, and thus held in place. Comminuted fracture of this portion of the shaft is not uncommon, especially in old subjects, laboring under fragility of the osseous tissue.

The accident may be the result of direct violence, as a kick or the passage of the wheel of a carriage, in which case it is often of a compound or complicated character; or it may be occasioned indirectly by a fall upon the foot or knee.

Fractures of the Inferior Fourth of the Shaft.—Fracture of the inferior portion of the shaft of this bone derives a special interest from the fact that, when occurring very low down, the inferior end of the upper fragment may, especially if it be very long and sharp, penetrate the joint, and thus seriously complicate a case otherwise easy of management. The fracture, moreover, is liable to be compound, the upper piece piercing the muscles and integuments just above the knee. As in fracture of the other divisions of the shaft, already described, so in this the line of the solution of continuity generally ranges from behind forwards and from above downwards, a transverse fracture, properly so termed, being extremely uncommon. The degree of obliquity is variable, but generally it is so considerable as to cause great shortening of the limb and angularity of the part; which, together with the everted state of the knee and foot, are characteristic signs of the accident. The inferior fragment is always drawn backwards and upwards, its superior extremity forming a distinct prominence in the popliteal region, which can easily be effaced by restoring the pieces to their natural position. When the fracture occupies the lower extremity of the shaft, nearly on a level with the joint, the upper fragment may descend so far down as to push the patella away from the trochlea of the femur, over upon the tibia, so as to create an appearance simulative of partial luxation of this little bone. If several hours have elapsed since the receipt of the injury, the diagnosis is sometimes obscured by the tumefaction of the joint; but, in general, whatever may be the condition of the parts, any existing doubt may be cleared up by a thorough examination of the limb.

The relative position of the fragments in this fracture are well depicted in fig. 428, from a specimen in my cabinet.

Fig. 428.



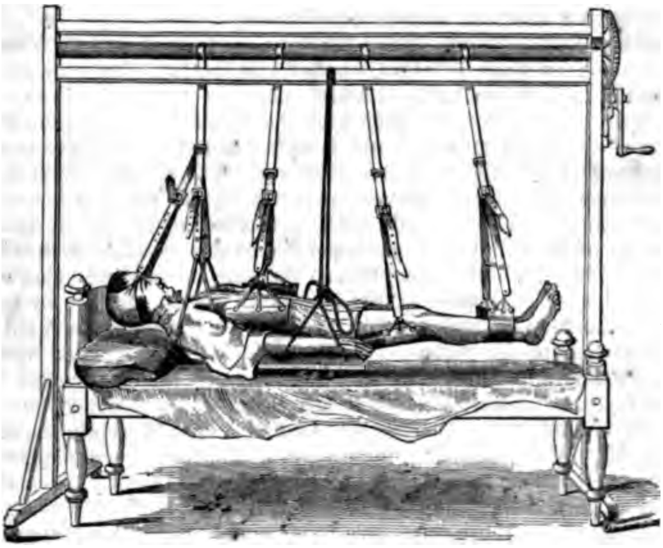
Fracture of the thigh.

The causes of fracture in this situation are commonly of a direct nature, a greater amount of force seeming to be necessary to produce it than when it is situated higher up. It may, however, be induced in an indirect manner, as when a person, falling from a considerable height, alights upon his foot or knee, the violence of the shock being concentrated upon the inferior portion of the femur.

Treatment.—The treatment of fractures of the shaft of the thigh-bone may be conducted according to several plans, of which that by extension and counter-extension, the limb being in the straight position, is, as a general rule, the most eligible, fulfilling, as it does, more effectually than any other, the different indications presented by this class of injuries. Before any steps, however, are taken to adjust the broken pieces, it is the duty of the attendant to see that a suitable bed is procured for the comfortable accommodation of his patient, as well as for the secure management of the case. This subject having already been discussed in a previous part of the work, it will, therefore, be sufficient for my present purpose, if I merely allude to it here, with the hope of enforcing its importance upon the mind of the reader. I am so thoroughly convinced of the utter impossibility of treating fractures of the femur successfully without a good bed, that I should consider any surgeon justifiable in declining to undertake the management of any case unless his efforts were properly seconded in this respect. There must be no compromise upon the subject; for, if the cure turn out badly, no allowance will be made by the patient and his friends for any deficiencies, short-coming, or want of co-operation on their part. The whole blame falls upon the professional attendant, it being very properly assumed that he ought to know better than any one else. what the emergency demands, and that he should, therefore, spare no pains to meet it. Every fracture-bed should have slats, a good, firm, but elastic mattress, and arrangements for the evacuation of the bowels, so that the patient may not be compelled to rise when he wishes to relieve himself. These essentials are all admirably combined in the ingenious contrivances of Dr. B. H. Coates, Dr. Addinell Hewson, and others, which my limits, however, will not permit me to describe.

When both thighs are broken, or even when only one is affected, Jenks's fracture-bed, represented in fig. 429, will be found extremely convenient, both for evacuating the bowels and for making up the bed. It is thus described by Dr. Gibson:—

Fig. 429.



Jenks's fracture-bed.

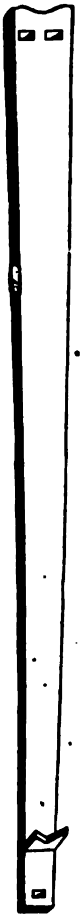
"It is composed of two upright posts about six feet high, supported each by a pedestal; of two horizontal bars, at the top, somewhat longer than a common bedstead; of a windlass of the same length placed six inches below the upper bar; of a cog-wheel and handle; of linen belts, from six to twelve inches wide; of straps secured at one end of the windlass, and at the other having hooks attached to corresponding eyes in the linen belts; of a head-piece made of netting; of a piece of sheet-iron twelve inches long, and hollowed out to fit and surround the thigh; of a bed-pan, box, and cushion to support it, and of some other minor parts."

For the purpose of securing quietude of the limb, and accuracy of apposition of the ends of the fragments, numerous contrivances have been devised, all possessing, apparently, more or less merit, and yet not one of them so perfect as to be wholly unexceptionable. A bare description and delineation of all the fracture apparatus now before the profession would form a stately volume. The surgical cabinets of some of our medical schools contain cart-loads of such material, most of it as effete as the contents of a curiosity-shop. Much of this apparatus has been patented, and extensively distributed by the inventors. The character of most of it is familiar to me, and I do not hesitate to declare that a large proportion of it is most villainous. The great and fundamental principles which every contrivance of the kind must necessarily possess is enjoyed by all, though in different degrees of perfection, and it cannot be doubted that the constant multiplication of such machinery, and the implicit confidence reposed in it by the younger members of the profession, have been a prolific source of the many disastrous results that have so frequently, especially of late years, attended the treatment of fractures of the thigh. I have long been satisfied that the more simple the apparatus is, the more easily is it managed, and the more likely to prove efficient. With a proper knowledge of what is needed, and a little ingenuity on the part of the surgeon, the requisite means for the successful management of almost any case of fracture of the femur, however bad, may generally be provided upon the spur of the occasion, or, at all events, within a reasonable time after the occurrence of the injury.

In children, I have usually found the most convenient and suitable apparatus to be a case made of stout, unoiled sole-leather, long enough to extend from the groin to an inch and a half below the heel, and sufficiently wide to come well round the limb, especially the thigh. It is supplied with a foot-piece of the same material, and is well padded at its upper extremity, to prevent undue pressure upon the perineum. The outside portion of the trough is continued for some distance over the hip, to which it is secured by a spica, or common roller, carried round the thighs and pelvis. A splint, also of leather, or of binder's board, gutta-percha, or thin wood, is stretched along the forepart of the limb from the groin to the patella, wadding being suitably interposed to ward off pressure; the apparatus is held in place by means of an ordinary bandage, adhesive strips having been previously secured to the leg and attached to the foot-piece. The dressing is completed by placing the limb, with its apparatus, in an easy position upon a hair or cotton bolster, gradually tapering upwards, its thickness below not exceeding four inches. By this simple contrivance I have always found it easy to obtain the requisite extension and counter-extension, the perineum affording a *point d'appui* which effectually prevents the ascent of the apparatus, while the foot-piece serves to keep the foot in place, at the same time that it receives the extending bands.

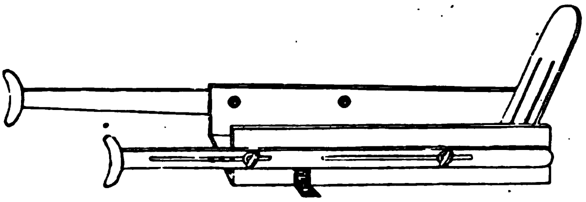
In fractures of the thigh-bone in adults, a more substantial apparatus is usually necessary, as there is generally a greater tendency to muscular contraction and displacement of the fragments. The apparatus which is usually employed in this country is that of Desault, as modified and improved by Physick, consisting of one long splint, fig. 430, extending from below the sole of the foot to the axilla, and of a short one extending from the same point to the perineum. They are connected below by a transverse bar, for receiving the extending bands, and along the leg and thigh by strips of bandage. The counter-extension is effected by a suitable thigh belt, the ends of which are passed through the mortise holes near the upper end of the splint. The apparatus is, however, an awkward one, constantly subject to derangement, and the results obtained by its aid are by no means so gratifying as they should be. It has always been found extremely unsatisfactory in my practice, and hence I have, for many years, never employed it in a single case, having given the preference to the fracture-box, represented in fig. 431. This box, which I used, for the first time, upwards of twenty years ago, extends from the tuberosity of the ischium to a level with the sole of the foot, which rests against the vertical piece, provided with two slit-like holes for the passage of the extending bands. The posterior surface of the box is hollowed out for the more easy accommodation of the thigh and leg, while the side-pieces, fastened by hinges to the horizontal one, project so as to come to a level with the surface of the limb in front. To the outside of the box is secured a movable splint, about two inches in width, crutch-shaped and well padded above, and long enough to reach into the axilla, while another, similarly arranged and constructed, is attached to the inside, being intended to press against the perineum. The whole apparatus is made as light as possible, and any intervals that may exist between it and the limb, after it has been properly adjusted, may be filled with cotton, tow, or, what is preferable, especially in compound fractures, with wheat bran, the latter answering an admirable purpose, under such circumstances, not only affording an agreeable protection to the broken bone, but absorbing the discharges and preventing the development of maggots, which are so liable to form in such cases in hot weather. In changing the dressings, all that is necessary is to let down the sides of the box, the extension being kept up, if necessary, in the meantime, by an assistant having hold of the foot. A broad feather splint, or one of binder's board, extending from the groin to the knee, should cover the thigh in front; it should be accurately moulded to the parts, and be firmly secured in its place by means of pieces of tape encircling the box.

Fig. 430.



Physick's long splint.

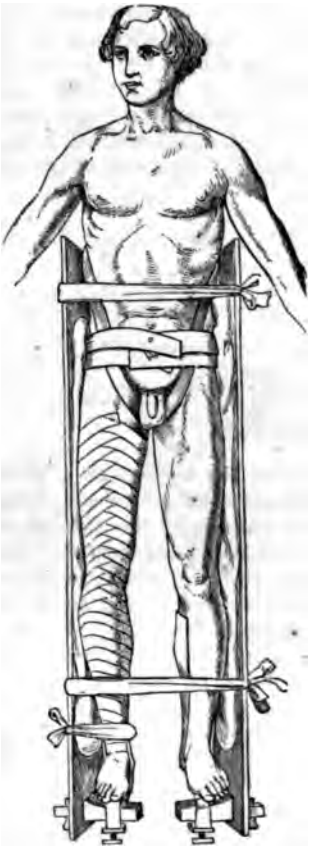
Fig. 431.



The author's fracture apparatus.

Instead of the fracture-box now described, use may be made of two splints, one of binder's board and the other of wood, the former, which is intended for the inside of the thigh, reaching from the groin to the knee, while the other, placed along the outside of the limb, extends as high up, on the one hand, as the crest of the ilium, and, on the other, as low down as four inches below the level of the sole of the foot. These splints being well padded, are secured with an ordinary roller, the adhesive strips being attached to the inferior extremity of the long one, in order to keep up the requisite degree of extension.

Fig. 432.



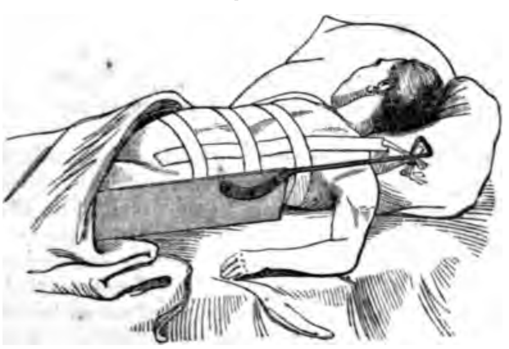
Dr. Gilbert's fracture apparatus.

Within the last few years adhesive plaster has been much employed in this city, both for maintaining extension and counter-extension in fractures of the thigh, chiefly through the influence and writings of Dr. Gilbert and Dr. Neill. The practice, which is rapidly coming into general vogue, is unquestionably, as stated elsewhere, a great improvement upon the ordinary means heretofore in use, as it not only tends to preserve better and closer union of the ends of the fragments, but, what is a matter of great moment to the patient, prevents the pain, chafing, and ulceration, which so frequently attend the old methods. The treatment is equally serviceable in simple and compound oblique fractures of the lower extremity.

In a remarkable case of compound fracture of both thigh-bones, in a boy eleven years of age, recently under the care of Dr. Gilbert, a most excellent cure was effected by means of adhesive plaster, aided by the apparatus, represented in fig. 432; the dressings being removed on the forty-fifth day. A long splint, it will be perceived, was stretched along the outside of each limb, from a few inches below the sole of the foot to within a short distance of the axilla; the extending strips, tied under the sole of the foot, and secured to a horizontal block, were controlled by a tourniquet; while the counter-extending strips were carried along the pelvis, both in front and behind, and firmly fastened by transverse bands passed round the hip-bones, the back, and abdomen.

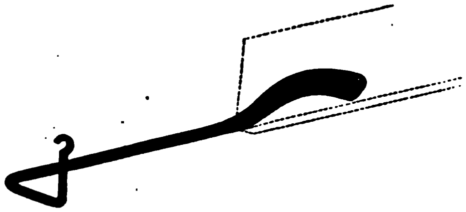
A valuable addition to the long splint, affording increased means for making counter-extension, was suggested, in 1860, by Dr. H. Lenox Hodge, of this city. It consists, as will be seen by a reference to figs. 433 and 434, of a bar of wrought iron, secured to the outer and upper part of the splint by bolts with movable nuts, and bent to the right or left, in accordance with the side to which it is applied. The splint should be sufficiently wide above to permit the rod, which terminates in a horizontal hook, about six inches in length, to pass clear of the patient's arm and shoulder. A long strip of adhesive plaster, at least two inches and a

Fig. 433.



Dr. Hodge's method of counter-extension in fracture of the femur.

Fig. 434.



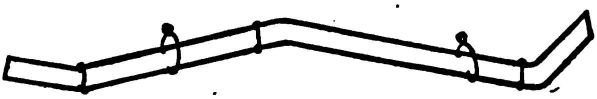
Bar of wrought iron for counter-extension.

half in breadth, is extended along the front of the body from the pelvis to the top of the shoulder, and thence down the back to the buttock, leaving, as it crosses the shoulder, a short loop, in which is placed a small block of wood, which is fastened by means of a tape to the hook of the bar. To prevent the long strip from becoming detached, the body is completely encircled, at different heights, by three horizontal bands.

The advantages of this contrivance are, that the extension and counter-extension are made in a straight line, that the dressings maintain their place much longer than the ordinary ones, and, lastly, that, as the patient cannot sit up in bed, there is less danger of displacement of the ends of the broken bone. The only objection to it is that the circular adhesive bands might impede the respiration, but any trouble that might thus arise will generally speedily disappear of its own accord.

Professor N. R. Smith has for a long time treated fractures of the thigh with great ease and success, with what he calls the *anterior splint*. It consists, as seen in fig. 435, of a single piece, made of wire, of the size of a No. 10 bougie, and bent at each extremity, the whole representing the form of a long parallelogram, three inches wide above, and two inches and three-quarters below. It must be long enough to reach from a point a little above the anterior spinous process of the ilium to an inch beyond the toes, when the thigh, leg, and foot are extended, three feet eight inches being a good average length for adults. The side-pieces are firmly connected by cross-pieces at a distance of about eight inches. Thus constructed, the wire frame is easily bent to suit the case in hand. The angle at the tibio-tarsal joint, six inches from the extremity, is about 120°, to secure an easy posture for the foot; that at the knee and the one at the hip are each about 160°, the latter being seven inches from the upper extremity.

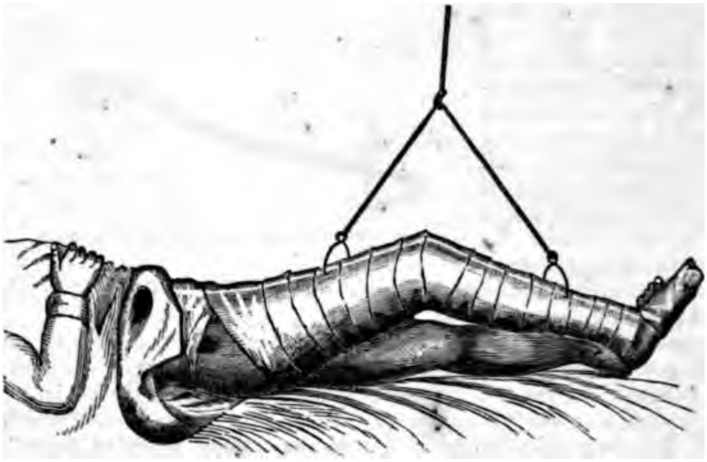
Fig. 435.



Dr. N. R. Smith's anterior splint.

The splint, properly padded or tightly wrapped with a muslin bandage, and secured to the limb by a roller extended from the toes upward, is suspended, by means of a pulley, cord, and loops to the ceiling, as represented in fig. 436, a compress being placed upon the instep and another upon the groin, to ward off pressure. The proper position of the hooks is a matter of great consequence. In general, the upper one should be attached nearly over the seat of the fracture, and the lower a little above the middle of the leg, the object being the thorough equalization of the pressure of the splint. The roller, confining the apparatus, should be well stitched to prevent it from slipping, and great care taken that it do not make undue constriction. This apparatus, the efficacy of which has been thoroughly tested in numerous cases, is exceedingly light and comfortable, and is equally well adapted to fractures of the thigh and leg, in every portion of their extent.

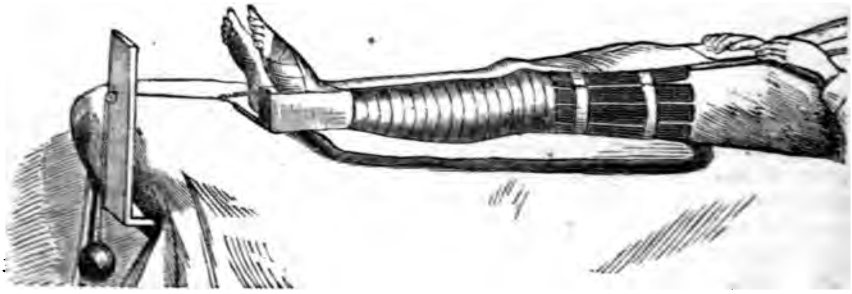
Fig. 436.



Dr. N. R. Smith's mode of treating fractures of the thigh.

An excellent mode of treating fractures of the thigh, attended with very gratifying results, and originally suggested by Dr. Gurdon Buck, is pursued at the New York Hospital. The long splints are entirely dispensed with, the extension being made by the action of a weight and pulley, and counter-extension by the usual perineal strap lengthened out and fastened to the head of the bedstead. A piece of adhesive plaster, from two and a half to three inches in width, is stretched along the sides of the limb, to a short distance above the knee, and confined with a roller extended from the toes up, the middle of it forming a loop below the sole of the foot. A thin block of wood, the width of the plaster, and long enough to prevent pressure over the ankle, is inserted into the loop, and thus serves to receive the extending cord, which is fastened to an elastic rubber band passing round the block, and playing either over the footboard of the bedstead, or, if there is none, a temporary frame, perforated at a height of about five inches above the level of the mattress. The thigh, at the seat of fracture, is surrounded with short splints, the heel is supported upon a thin, wedge-shaped hair cushion, and a bag, filled with sand or bran, is placed along the outside of the leg and foot to prevent rotation. The amount of weight to be employed must be determined by the age of the patient and the other circumstances of the case. A child

Fig. 437.

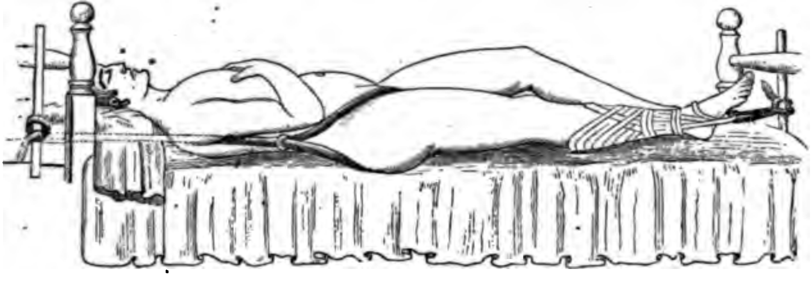


Dr. Buck's fracture apparatus.

under eight years of age will seldom require more than five or six pounds, while an adult may require from fifteen to twenty. The most suitable perineal band is a piece of India-rubber tubing, of one inch calibre, two feet in length, with a ring at each end, stuffed with bran or cotton lampwick, and covered with canton flannel, wrapped spirally round it, and renewed whenever it becomes soiled. The apparatus of Dr. Buck is represented in fig. 437.

The treatment of fractures of the thigh, lately introduced by Dr. Swinburne, recommends itself by its simplicity and efficiency, and deserves, in my judgment, the favorable consideration of the profession. It consists, as will be seen by a reference to the annexed sketch, fig. 438, exclusively of extension and counter-extension, without splints, the perineal and crural bands being secured to the bedstead, as in Dr. Buck's apparatus, and composed of similar materials. Free use is made of adhesive strips at the leg and foot, and also, if necessary, at the thigh. With such an arrangement, the affected limb may be inspected or measured as often as may be desired, all danger of embarrassing the circulation is done away with, perfect cleanliness may be preserved, and any topical applications that may be required may be made and removed with the utmost facility. The advantages of this method are particularly conspicuous in complicated fractures of the thigh. Dr. Swinburne states that he has treated in this manner upwards of forty cases of fractures of the femur and tibia with very little, if any, shortening, except in the intra-capsular form of the accident.

Fig. 438.



Dr. Swinburne's method of treating fractures of the thigh.

Whatever apparatus be employed, whether those now described, or others of a similar character, there are several circumstances which should claim the special attention of the practitioner in the treatment of fractures of the shaft of the femur, and which may be stated in the form of aphorisms.

1st. Care must be taken that the ends of the broken bone are steadily maintained on a line with each other; any tendency to angularity, lateral distortion, or tilting up of the fragments must be promptly counteracted by pressure opposite the point of projection. This disposition manifests itself, more or less, in nearly all fractures of the femur, and should never for a moment be lost sight of, lest it be not discovered until it is too late to remedy it. It is particularly strong when the fracture is seated from two and a half to three inches below the small trochanter, in consequence of the action, on the one hand, of the iliac and psoas muscles, and, on the other, of the external rotators; the former, as before stated, tilting the lower end of the superior fragment forwards, and the latter outwards. For want of attention to this circumstance, wretched deformity of the limb is a frequent consequence of this lesion.

2d. Proper care must be taken that no *shortening* occurs. To prevent this, constant vigilance must be exercised in regard to the tightening of the extending and counter-extending bands. If any doubt exist, a comparative estimate must be made from time to time of the length of the two limbs, by stretching a piece of tape from the centre of the umbilicus to the inferior and inner border of each patella, the body and limbs lying perfectly straight.

3d. A slightly *everted* condition of the limb being that which is most natural when the body is dorsally recumbent, the surgeon should aim to maintain it in that position during the period necessary to obtain reunion of the ends of the broken bone.

4th. The *heel* must be seen to; for if it be neglected it will be sure to inflame and ulcerate, if not slough. Too much care, therefore, cannot be taken to ward off pressure by filling up the hollow on each side of the tendo Achillis with cotton, or employing, if necessary, a small air-bag, or a bladder partially filled with water.

5th. *Extension* must be maintained with two broad strips of adhesive plaster, stretched along the sides of the leg nearly as high as the knee, secured by cross-pieces, and fastened to the foot-board of the splints or fracture-box; the surface being carefully shaved prior to their application. Or, instead of this, two long and broad strips of linen or muslin are secured to the limb by means of a roller, the upper extremity of each being turned loop-like down upon itself, over the bandage, and fastened by carrying the roller downwards. The gaiter and handkerchief should not be used in any case, for reasons previously mentioned.

The *perineal band* must also receive due attention, otherwise it will be sure to gall and fret the parts, and thus greatly distress the patient. Besides, if not properly managed, it will be extremely apt to displace the upper fragment, by pushing it outwards, away from the inferior.

6th. In *compound fractures*, one of the splints may be bracketed, as originally recommended by Dr. Hayes, of Indiana, the method having been adopted by him during our war with England, in 1813 and 1814. The opening which is thus left affords ready access to the wound, and, consequently, great convenience for the application of the necessary dressing.

7th. Much objection has been urged by certain writers against the *bandage* in the treatment of fractures of the thigh, on the ground not only that it is inconvenient, but absolutely useless. My experience does not corroborate this statement. On the contrary, I have always derived the most marked benefit from it, and would not, therefore, on any account, omit it. While I should hardly know how to control muscular spasm without it, it is one of the most powerful means we can employ to counteract the tendency to shortening, so common in nearly all fractures of the thigh. To answer the purpose, however, it must be applied with great care; otherwise harm, not benefit, will result.

In simple fractures of the thigh, the ordinary roller is sufficient, but in compound fractures preference is given to the bandage of Scultetus, inasmuch as, being composed of separate strips, it admits of more easy removal and reapplication.

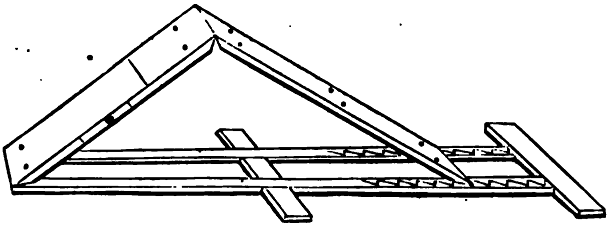
The *starch bandage* may often be employed with great advantage, giving adequate support to the broken limb, and enabling the patient to take exercise in the open air, or about the house, upon crutches, a matter frequently of great importance. My experience, however, is averse to its use in the early stage of the treatment; applied too soon after the accident, before there is pretty complete subsidence of inflammation and swelling, it may do incalculable harm, not only greatly aggravating the local trouble, but endangering the safety of the limb by the induction of gangrene. For these reasons, therefore, I seldom resort to it before the end of a fortnight or the beginning of the third week.

8th. Care must be taken to keep off the bedclothes from the fractured limb, as their weight would not only be oppressive, but tend to derange the ends of the fragments. A good and ready mode of accomplishing this is to cut a stout barrel hoop through at the middle, and to place the two halves, tied firmly together, crosswise, over the injured extremity. Or, instead of this apparatus, the surgeon may use, what is much better, the frame depicted at page 937.

Mr. Pott, of England, conceived the idea that the best mode of treating fractures of the femur was to place the affected limb upon its outside, the body inclining in the same direction, and the knee being in a semi-flexed state. The leg and foot, supported upon smooth pillows, were elevated somewhat above the level of the thigh, which was enveloped by a many-tailed bandage, and covered in by two broad, carved wooden splints. This plan, which Mr. Pott recommended with all the enthusiasm of a man of genius, was founded upon the erroneous notion that it would completely relax the different sets of muscles connected with the broken bone, thus preventing them from acting injuriously upon its fragments; forgetting that, in proportion as he took off the tension from one class, he necessarily increased that of another. It has been found altogether impossible to carry out this plan successfully in practice, experience having shown that the patient is utterly unable to remain so long in one position without suffering greatly from bed-sores, and that the apparatus, with all the care that can be taken to keep it in place, is wholly inadequate to answer the purpose of an accurate adjuster.

Another mode of treating fractures of the body of the femur, quite different from any hitherto described, was much in vogue at one time, both in England and in this country, chiefly in consequence of the influence of the late Sir Charles Bell, by whom, if it was not originated by him, it was extensively employed for a long time at the Middlesex Hospital, London. It consists in placing the limb upon two grooved cushions, resting upon two pieces of board, united by hinges in the form of a double inclined plane, as seen in fig. 439, and long enough to extend from the tuberosity of the ischium to the back part of the heel. A roller having been previously applied from the toes to the groin, two light, but firm binder's board splints, carefully softened in hot water, are secured to the outer and inner parts of the thigh, meeting nearly in front, and reaching from the groin to the knee. The extremity is now laid over the inclined plane, in an easy, comfortable position, the angle of flexion having special reference to this point; the foot is attached to the foot-board, and the limb and plane being tied firmly together by tapes, or, what is better, a bandage, the dressing is completed.

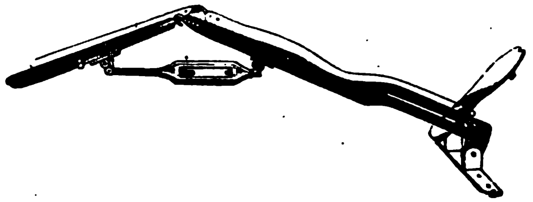
Fig. 439.



Double inclined plane of Sir Charles Bell.

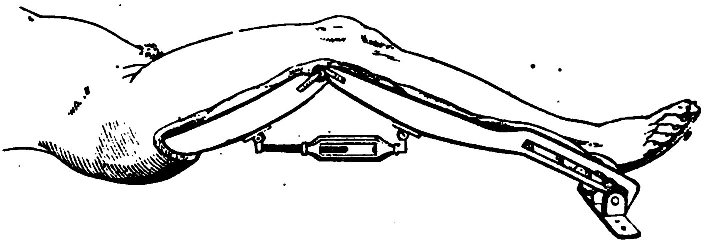
The method of treatment by the double inclined plane ought not to be too lightly condemned, for it cannot be denied that very excellent cures are occasionally effected with it. Much less frequently employed now than formerly, it is more particularly applicable to the treatment of fractures of the condyles of the femur and of the upper extremity of this bone, attended with a constant disposition to displacement of the lower extremity of the superior fragment. It may also be advantageously employed in compound fractures, attended with severe contusion and laceration of the integuments, where confinement in the extended position would be productive of violent pain and extreme discomfort. The extension is made mainly by the weight of the leg and foot, while the counter-extension is made by the pressure of the apparatus against the tuberosity of the ischium. The annexed drawing, fig. 440, represents M'Intyre's splint, or double inclined plane, modified by Liston. Fig. 441 exhibits it as it is applied to the limb.

Fig. 440.



M'Intyre's splint, simplified and improved by Liston.

Fig. 441.



M'Intyre's splint applied to the limb.

Finally, when *both thighs* are broken the case may be treated with a double inclined plane, or a fracture-bed, the hinges being arranged in such a manner as to permit the trunk to be raised or lowered at pleasure, without causing any motion of the hips. The limbs should be well protected with side and front splints, and be immovably tied together.

The period required for the consolidation of fractures of the shaft of the femur must necessarily be greatly influenced by circumstances, as the age and health of the patient, and the care with which the ends of the fragments are kept together. In children of from five to fifteen years, complete union may usually be looked for in from twenty-four to twenty-eight days. In eighteen cases, analyzed by Dr. A. L. Peirson, of Massachusetts, the cure in persons of thirty years of age and under, occupied 35.88 days; while in seventeen, where the age was upwards of thirty, the average period was 36.64 days; thus showing only a very trifling difference in the two series.

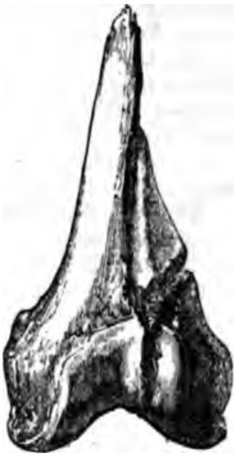
It has been asserted by many highly respectable practitioners that it is always extremely difficult, if not impossible, to effect a cure in fractures of the shaft of the thigh-bone without some degree of shortening, and my opinion is that this conclusion is only too well founded. There can be no question at all that in many cases a certain degree of shortening is absolutely and positively unavoidable, not on account of any defect in the treatment, but from the very nature of the fracture itself. How is it possible it should be otherwise, when the ends of the fragments are driven the one into the other? The best skill and the most devoted attention would utterly fail, under such circumstances, to make a good limb. So, also, when the fracture is compound or comminuted, more or less deformity and shortening will almost be inevitable. In the New York Hospital, where fractures of the shaft of the thigh-bone are very common, and where this accident is probably treated with as much adroitness and care as anywhere in the world, from a third to half an inch of shortening is generally looked for, as a natural consequence, by the surgeons of the Institution, and it is questionable whether the statistics of other similar establishments, if they could be ascertained, would exhibit a more favorable result.

2. FRACTURES OF THE INFERIOR EXTREMITY.

Fracture of the condyles of the femur is, in comparison with that of the humerus, an extremely infrequent occurrence. Indeed, it is very uncommon, not only relatively, but absolutely speaking. Sir Astley Cooper mentions only two instances of the kind in his work on Dislocations and Fractures; the Dupuytren Museum at Paris, so rich in osteological preparations, contains but five specimens of the lesion; and in the Mütter collection, not a single bone, illustrative of the occurrence, is met with. The cabinet of Professor Gibson, the elder, now at Richmond, has, however, several beautiful specimens of fracture of the condyles; and among my own preparations is a very rare one, in which these eminences are broken off vertically, leaving the trochlea attached to the lower end of the shaft which exhibits a remarkably comminuted appearance, consisting of not less than five distinct fragments.

The fracture may be limited to one of the condyles, which, however, is extremely rare, or it may implicate both, the fissure in the latter case extending between the two prominences, and terminating above in an oblique fracture of the shaft, so as to give rise to three distinct fragments. From the amount of force required to produce this fracture, it is generally attended with a great deal of injury to the soft parts, and, for the same reason, it is not unfrequently of a compound and comminuted character, the ends of the fragments protruding either externally or projecting into the cavity of the knee-joint. A partial fracture of one of the condyles occasionally occurs. In rare cases, the fracture presents the character of impaction, the lower end of the shaft being forcibly impelled into the cancellous structure of the condyles, which are completely severed in their entire length. Fig. 442 conveys an excellent idea of a fracture of the external condyle from a drawing of Sir Astley Cooper.

Fig. 442.



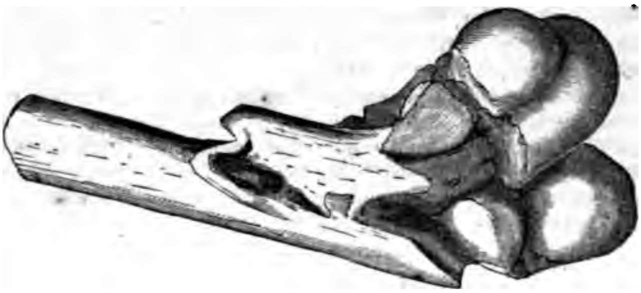
Fracture of the external condyle.

Whatever form the fracture may assume, it is nearly always the result of direct violence; generally of a fall upon the knee, the passage of the wheel of a carriage, or the kick of a horse. In one of the three cases that have fallen under my observation, it was occasioned by a fall from a high scaffolding, the individual, a man upwards of fifty years of age, alighting upon his feet, but striking, before he could recover himself, his knee against a large stone. The subjects of these fractures are usually old persons, in whom the condyles of the femur have become atrophied and brittle from the effects of interstitial absorption and fatty degeneration.

The *symptoms* of fracture of the condyles are not always well characterized, owing to the fact that the fragments are generally held in place by the ligaments of the knee, thus preventing marked deformity, and rendering the production of crepitus difficult. The joint appears to be wider and flatter in front than usual, and if the patella be pressed backwards, the condyles may be considerably separated, so as to increase the transverse diameter of the limb. The joint is much swollen and bruised, the member is completely powerless, and, when the fracture affects both prominences, there is nearly always marked shortening, often amounting to from one to two inches, the lower fragment being drawn up behind the superior by the action of the hamstring muscles. When only one condyle is broken, the deformity, other things being equal, will be less than when both suffer, and there will also, of course, be less shortening.

In the specimen of vertical fracture of the condyles in my cabinet, previously alluded to, the short fragment is drawn upwards against the posterior surface of the shaft of the femur, to the distance of at least two inches, its upper surface looking towards the trochlea, with which it forms an obtuse angle, thus greatly increasing the antero-posterior diameter of the joint. The various appearances of this rare specimen are well represented in fig. 443.

Fig. 443.



Comminuted fracture of the lower extremity of the femur.

Fracture of both condyles occasionally simulates a partial luxation of the head of the tibia backwards. In a case reported by Professor Neill, the symptoms resemble much more those of an accident of this kind than those of a fracture of the condyles. The leg being thrown backwards, rendered the patella remarkably prominent in front, but there was no increased breadth of the knee, no crepitus, and no contortion of the foot, at the same time that it was easy to flex and extend the joint. The best diagnostic consists in taking hold of the condyles, and attempting to press them in opposite directions, which cannot, of course, be done, if there be no fracture. The same procedure can hardly fail to elicit crepitation, although this may be rather slight, especially if the fragments are held pretty firmly together by the ligaments.

The *prognosis* of this fracture is especially grave, on account both of the injury done to the soft parts, and of its connection with the joint, which may be involved in an alarming degree. The fracture may, as already stated, be compound or comminuted, and when this is the case, the danger will, of course, be greatly increased, perhaps to such an extent as to require amputation, or, when this is not deemed advisable, in such a manner as to jeopard life by mortification, pyemia, erysipelas, or congestive pneumonia.

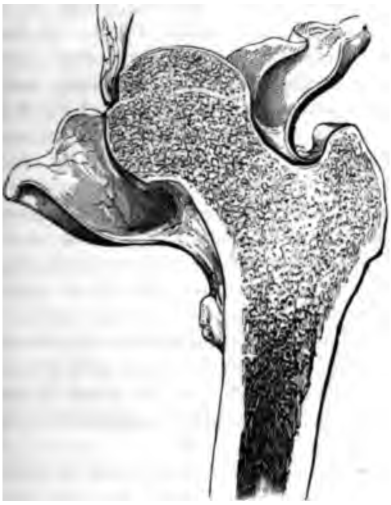
The *treatment* will usually require, in the first instance, to be strictly antiphlogistic, leeches and evaporating lotions being necessary, on account of the injury done to the soft parts. The limb, enveloped in a bandage, is laid in an easy position, and free use is made of anodynes in order to prevent spasm, so common and annoying after these accidents. As soon as the inflammation has been sufficiently subdued, the fragments are restored to their proper position, and maintained by appropriate apparatus, the limb being extended, if the fracture be transverse, or nearly so, or placed over a double inclined plane, if it be very oblique, with a strong tendency to displacement of the broken ends. Passive motion is instituted at the expiration of a month, but, despite the attention of the surgeon, a good and unexceptionable cure will be extremely difficult, if not impossible, especially when both condyles are implicated.

Complicated fractures of the condyles are occasionally met with, principally as the result of direct violence, such as the passage of the wheel of a carriage, or of gunshot injury, and are among the most dangerous of accidents, bringing life in jeopardy by tetanus, erysipelas, pyemia, and profuse suppuration and hectic irritation. The danger is proportionately increased when the lesion is attended with extensive wound of the knee-joint, or a comminuted condition of the bone. An attempt may be made to preserve the limb when the patient is young and in good health at the time of the fracture, when the weather is not too hot and exhausting, and when the injury in the soft parts is comparatively slight; under opposite circumstances, on the contrary, the best plan will be to amputate on the spot, immediately after the occurrence of reaction. To hesitate, in such a case, would only be to trifle with the patient's life, which could hardly fail to be the forfeit of the surgeon's timidity.

3. FRACTURES OF THE SUPERIOR EXTREMITY OF THE FEMUR.

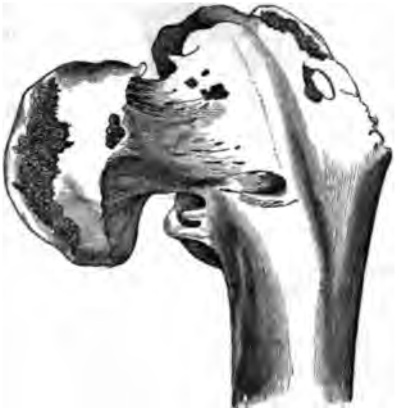
The superior extremity of the femur comprises the head and neck of that bone, together with the two trochanters, so that in an individual of ordinary stature it is from three inches and a quarter to three inches and a half in length, there being, however, no distinct boundary line between it and the shaft. The head composes nearly two-thirds of a sphere, and rests upon the neck, which is inclined obliquely upwards and inwards, so as to form an obtuse angle with it; they are surrounded by the capsular ligament, the

Fig. 444.



Natural appearances of the head and neck of the femur.

Fig. 445.

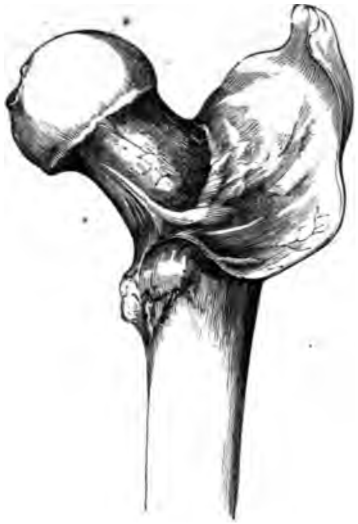


Alterations of the head and neck of the femur from the effects of old age.

strongest membrane of the kind in the body, an
of spongy tissue, inclosed by a thin lamella of
these structures undergo important changes in co
the former becoming greatly rarefied, light, and
attenuated as to be, in some places, hardly as th
These changes, the necessary effect of which is
frail and brittle, are particularly conspicuous aft
principal cause of the frequency of fracture of t
after this period of life. There is another circu
fully contributes to this occurrence, and that is tl
tion of the neck of the femur undergoes, causing
off almost at a right angle with the shaft of the
this level. This change in the obliquity of this
general rule, more common, as well as more mar
and hence it is that the former are always more l
of the femur than the latter. These various app
in the adjoining sketches. Fig. 444 represents t
the head and neck, together with its spongy and cc
from a preparation in my collection, affords a go
these parts experience in consequence of the effe

A thorough knowledge of the disposition an
ments of the
quence in tl
superior ext
it respects tl
reparation.
446, represer
is attached, c
phery of the
other, to the
tend, in fron
chanter to th
the head an
scends furthe
on the poste
is thicker an
than in any
Anteriorly,
psoas, iliac,
with a band
teriorly, by
inner obtura
the pectineal
cles; and sup

Fig. 446.



Head and neck of the femur with capsular ligament laid open.

The inter-s
ligament of a
gular bundle of fibres, which arises from the dep
femur, just below its centre, and is inserted by
the margins of the cotyloid notch of the acetabu

These two ligaments, maintaining the head an
proper position, generally sustain serious injur
extremity of the bone. When the lesion is intr
ment is usually completely torn across so as freq
of the upper extremity of the inferior fragment
the spot, or soon afterwards, thus accounting, i
ening experienced by the limb. The upper frag

on, as it were, to the round ligament, which thus supports and nourishes it, its vascular and nervous supplies being cut off in every other direction.

There is another point of great practical interest in the anatomy of the neck of the femur, which, from the influence it exercises over the repair of fractures, deserves brief mention here. I allude to the fact that this portion of the bone is nearly destitute of periosteum, thereby disqualifying it, in great degree, for the formation of callus, an occurrence which is still further opposed by the circumstance that this part is invested by a synovial membrane, which, in case of accident, always pours out a large quantity of fluid, the interposition of which between the ends of the fragments becomes thus a powerful obstacle to their reunion. Occasion will be afforded of speaking again of these various points as we proceed with the discussion of the nature and treatment of fractures of the neck of the femur.

Fractures of the neck of the femur are divisible into two classes, those, namely, which occur within the capsular ligament, and those which take place exterior to it; the former being now usually termed intra-capsular, and the latter extra-capsular. The distinction, as will be seen by and by, is one of great pathological as well as practical importance, and is, therefore, worthy of profound consideration.

INTRA-CAPSULAR FRACTURES.

Fracture of the neck of the femur within the capsular ligament may occur at any portion of this part of the bone, as exhibited in the accompanying figures, 447, 448, and 449; but, in general, it is met with at a short distance below the head, or between the head and centre of the neck, where the compact structure appears to be unusually weak, and where, consequently, the slightest force frequently produces the accident. Sometimes the line of fracture is on a level with the globular head, which, therefore, alone constitutes the upper fragment; and, on the other hand, cases are observed where the bone yields just above the attachment of the capsular ligament. Finally, the fracture is sometimes partly within and partly without the ligament, forming an interesting variety, especially in reference to the question of the process of consolidation. The direction of the fracture is usually oblique; but it

Fig. 447.

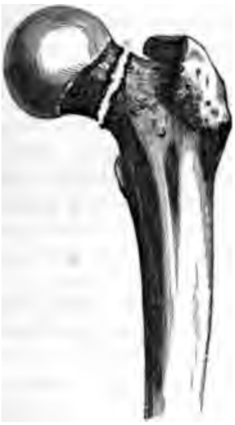
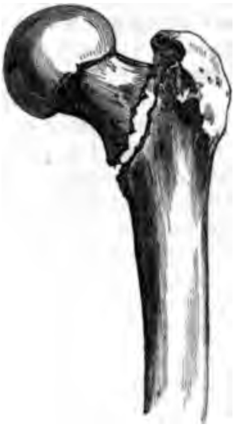


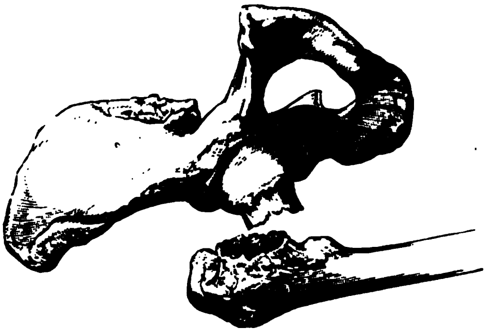
Fig. 448.



Illustrations of intra-capsular fracture.

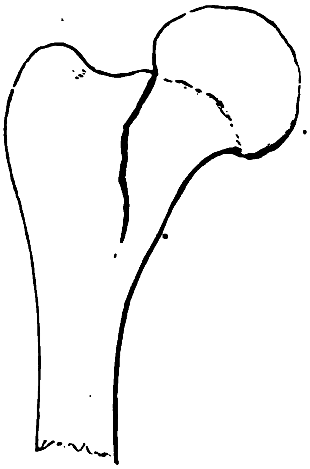
may be perfectly perpendicular, especially when the neck, in consequence of age or disease, forms a right angle with the shaft of the bone.

Fig. 449.



Intra-capsular fracture of the femur.

Fig. 450.



Vertical fracture of the neck of the femur.

An incomplete variety of intra-capsular fracture has been from time to time recognized by surgical observers, but much doubt has always been entertained by many in relation to the possibility of such an occurrence. I have myself never met with an example in the numerous dried specimens that I have examined in different collections, and I, therefore, assume that the accident must be extremely uncommon. A well-marked instance of the kind occurred in 1856 to Dr. J. B. S. Jackson, of Boston, in a man, aged forty-two years, in consequence of a fall through two stories of a building upon a hard floor, breaking his spine and the femur at several points. The fracture of the neck, commencing at its junction with the head, reached, as is seen in fig. 450, in a nearly perpendicular direction, to within about a quarter of an inch of the inferior and internal wall of the bone, the fissure being so extensive as that, if the man had been able to walk, the unbroken part could probably not have supported the weight of his body.

The *cause* of intra-capsular fractures is generally some trivial accident; most commonly a fall upon the great trochanter, or a blow upon the hip when the thigh is fixed and separated from its fellow, thus increasing the strain upon the upper portion of the bone. I have known the injury to be produced by the great toe catching in a fold of the carpet, while the person, an old lady of seventy-six, was walking across the floor. In London, according to Sir Astley Cooper, it most frequently occurs from the foot suddenly slipping off the edge of the side-walk over the curb-stone, upon the carriage pavement, the weight of the body being thus thrown forcibly upon the neck of the bone in a perpendicular direction, when it is unprepared for such an event. Cases are recorded of the fracture having happened in consequence of the individual having turned awkwardly in bed, or of having stepped carelessly out of the bed upon the floor, in either case powerfully twisting the thigh-bone. The fact that so serious a lesion may occur from so trivial a cause, while it is of great value in a diagnostic point of view, affords the clearest possible proof that a bone, liable to be so affected, cannot be very sound, but, on the contrary, that its structure must have undergone serious changes to render it capable of an accident, which, in other pieces of the skeleton, requires an extraordinary degree of force. That this is the case, as a general principle, has already been shown, the immediate cause being the fatty, atrophied, and rarefied condition of the compact and spongy tissues of the neck of the bone, the animal matter being absorbed, and the earthy alone left, the result of the whole being a weakened condition of the affected parts, and, consequently, a predisposition to fracture. Although the lesion is usually occasioned by slight accidents, yet instances are observed where the reverse is the case, but then it is worthy of remark that it is ordinarily of a complicated character.

The *age* at which this variety of fracture occurs is, diagnostically considered, a matter of great importance. A fracture in other bones, or parts of a bone, may take place at any period of life, even in infancy and early childhood. Thus, I have seen the shaft of the femur itself broken in an infant of four weeks. But it is very different with the neck of this bone within the capsular ligament, experience having shown that it is subject to fracture only, as a general rule, after the age of fifty, when, as already stated, its spongy and compact tissues suffer from atrophy and fatty degeneration, thus rendering it more or less brittle, and incapable of withstanding injury. The youngest subject in whom this fracture has been observed was a lady of eighteen, whose case has been reported by Mr. Stanley, of London. Sir Astley Cooper saw an instance at thirty-eight. Doubtless other examples have occurred, but they do not disprove the rule, that this variety of fracture is an occurrence of advanced life.

Sex also exerts a considerable influence upon the production of intra-capsular fracture. Of its precise relative frequency in males and females, no reliable statistics, at least none upon a large scale, have been placed before the profession; but a sufficient amount of information has been obtained to justify the assertion that it is much more common in the latter than in the former. In the Tables of Mr. R. W. Smith, of Dublin, in his Treatise on Fractures, the sex is given in twenty-eight cases, of which seventeen were women and eleven were men. The cause of this difference appears to be twofold, the more horizontal position of the neck of the thigh-bone and the greater amount of atrophy and fatty degeneration of this portion of bone in old females than in old males.

The intra-capsular fracture may be *complicated* with fracture of the neck on the outside of the capsular ligament, the lines of disjunction running into each other. Such an occurrence, indeed, is not infrequent. Again, an intra-capsular fracture may be associated with a fracture of the great trochanter; but this is extremely rare. In twenty-three specimens of this lesion in the Dupuytren Museum at Paris, there is not a solitary example of such a coincidence.

The *symptoms* of intra-capsular fracture are deserving of particular attention. They are: 1. Shortening of the thigh. 2. Eversion of the foot. 3. Preternatural mobility. 4. Crepitation. 5. Change of position in the great trochanter. 6. Pain at the site of injury. 7. Peculiarity of the patient's body in the erect position. Each of these symptoms, except, perhaps, the last, possesses a positive value, and must, therefore, be considered somewhat at length.

The *shortening of the thigh*, or of the limb through the thigh, is one of the most striking phenomena of this variety of fracture, and is the more valuable because of its almost universal occurrence. It is usually the first circumstance that attracts the attention of the surgeon, whether the patient be lying on his back, or standing up. As might be expected, it varies in different cases and in different conditions of the same patient, its extent being greatly influenced by the state of the capsular ligament, being generally less in proportion to the integrity of this membrane, and conversely. It is always less immediately after the occurrence of the injury than it is after the lapse of several days, and also in impacted fracture than in the ordinary form of the accident. The amount of immediate shortening ranges from half an inch to an inch; but it may be considerably less than this, not, perhaps, exceeding three lines; and, on the other hand, it may reach an inch and a quarter, and even an inch and a half, especially if there be extensive laceration of the capsular ligament. During the progress of the case, the shortening will not unfrequently amount to upwards of two inches, while in rare cases it has been known to exceed three.

The diminution in the length of the limb, although generally immediate, is not always so, depending, perhaps, not so much, as has usually been supposed, upon the integrity of the capsular ligament, as upon the want of separation of the ends of the fragments, in consequence of the peculiar arrangement of their surfaces favoring their temporary contact. It is hardly reasonable to imagine that, if the integrity of the capsular ligament were the only cause of it, this ligament would become so stretched or torn within so short a time after the accident as to admit of the amount of shortening above mentioned. We must, therefore, seek for some other cause, and I know of none that is so plausible as the one here suggested. Under such circumstances, the shortening generally takes place suddenly; perhaps after the patient has made considerable exertion with his limb, several days, it may be, after the accident, in consequence of the instantaneous unlocking, as it were, of the ends of the fragments. When the fracture is impacted, the shortening will, of course, be immediate, and will also be likely to be permanent, unless the broken pieces are pulled forcibly asunder by the surgeon in the examination of the limb, or by the patient in his efforts at walking or turning about in bed.

Eversion of the foot, or, rather, of the whole limb, is another striking and constant symptom, being seldom absent in any case. When the patient stands up, it is such as to cause the heel of the affected side to point towards the hollow between the ankle and tendo Achillis of the sound limb; while, when he is recumbent, the foot inclines outwards almost horizontally, dropping involuntarily upon its external surface, nearly, or quite, in contact with the floor. The eversion, although generally an immediate effect of the accident, does not always reach its maximum until some time after, depending upon the manner in which the ends of the fragments are held together. When the fracture is impacted, it may be entirely absent, or the foot and knee, instead of being everted, may be more or less turned in the opposite direction.

The cause of the eversion of the limb, in this accident, has been differently explained. Most writers ascribe it to the action of the external rotator muscles, which, being connected with the superior extremity of the bone, thus readily roll the thigh outwards when it has lost its support above, the irritation consequent upon the fracture being an additional incentive to contraction. Others, on the contrary, and I include myself among the number, attribute it altogether to the weight of the limb, which has a natural tendency to eversion whenever the internal rotators are thrown off their guard, as is observed during sleep, when, the extremity being perfectly passive, the foot invariably inclines outwards.

Preternatural mobility, common to all fractures, is particularly observable in the intra-capsular variety, and therefore serves as an important diagnostic sign of the accident. There are cases, however, in which it is absent; in some entirely, as in the impacted fracture, and in others only in the early stage of the injury, as when the ends of the bone are held partially together by the interlocking of their fibres, by the incompleteness of the solution of continuity, or by some other cause. Its existence, as well as its degree, is always readily ascertained by taking hold of the limb and rotating it upon its axis, or flexing it upon the pelvis, extending it behind the line of the sound limb, or carrying it inwards or outwards; movements which cannot be executed when there is a dislocation of the head of the femur. Extension and counter-extension will have the effect of restoring the limb promptly to its proper length, but as soon as the forces are discontinued the original shortening is reproduced.

Crepitation, the most valuable sign of all in fractures generally, is rarely wanting in this. Indeed, it can only be absent in the impacted form of the lesion, or in those cases where the ends of the fragments remain still partially in apposition with one another. In general, it is discoverable immediately after the accident, and may, of course, be produced as long as the fracture continues ununited. In ordér to determine its existence, it is necessary to bring the ends of the broken bone fully in contact by extension and counter-extension, when, upon rotating the limb, it will at once declare itself.

Change of position in the great trochanter is always a symptom of importance in intra-capsular fracture. This bony prominence is not only drawn upwards towards the ilium, in this accident, but it is brought in close contact with the border of the acetabulum, and is, therefore, much less easily felt and seen than in the normal state, in which it is always so conspicuous. Moreover, when the thigh is rotated upon its axis by taking hold of the foot, the great trochanter will be found to turn, as it were, upon a pivot, or to move in a segment of a lesser circle than natural. From the circumstance of the limb being generally strongly everted, the portion of the broken neck attached to the trochanter is directed inwards and upwards, being thus placed in closer proximity with the anterior superior spinous process of the ilium than the trochanter itself.

Pain at the site of injury, being common to all fractures, is of special value only in connection with the other symptoms already described. It derives its chief importance from the fact that it is located at the upper and inner part of the thigh, in the direction of the small trochanter, and that it is always greatly increased whenever an attempt is made to rotate the limb, to bend it upon the pelvis, or to carry it inwards over the sound one. When the patient is perfectly quiet, the limb being placed in a relaxed position, the suffering is usually very trivial, except in cases where the bone has received, in addition to the fracture, a severe degree of concussion, when the pain will frequently be excessive. It is generally worse, too, at night than in the day, and in wet weather than in dry.

There is a peculiarity in the *patient's attitude* as he stands up, which cannot fail to strike the most careless observer. The body, in this position, is inclined forwards in such a manner as to throw its weight upon the sound limb, which is firmly planted upon the floor, while the other hangs off in a constrained, unseemly, and awkward manner; the foot and knee are strongly everted; the leg is supported upon the ball of the toes, while the heel, resting in the interval between the ankle and tendo Achillis, is elevated from two to three inches from the surface; the natural prominence of the hip is destroyed; and the least attempt to walk or raise the limb not only proves abortive, but is productive of exquisite pain.

Finally, there is seldom much *swelling* in this variety of fracture; it is only when the hip has been struck a severe blow that the superficial parts are likely to be the seat of any considerable effusion, ecchymosis, discoloration, or contusion, and even then the symptoms are usually very evanescent.

The *pathological appearances* in intra-capsular fracture vary very much, according to the period of the examination, as well as the character of the original injury. In recent cases there is usually some sanguineous effusion, although the quantity of blood is generally very small, unless, as occasionall happens, there is a rupture of the capsular ligament, when it may be co siderable. Most commonly the ligament preserves its integrity, but if th accident has been unusually severe it may be torn at one or more points, s as to admit of the partial escape of the inferior fragment, the soft coverin of which is often partially detached, hanging off in loose, irregular shred If several days have elapsed since the receipt of the injury, the changes wi be such as are evincive of inflammation. The synovial membrane will b observed to be unnaturally vascular, and to be slightly coated with plasti matter, a small quantity of which is also sometimes found upon the ends the fragments. There is likewise, at this stage, a marked increase of synovi fluid, and the structures around the joint frequently exhibit a contused a pearance, with more or less infiltration of blood and serum.

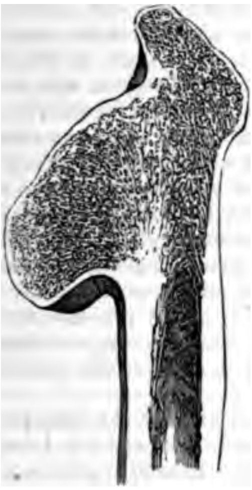
If the dissection be made after the lapse of some months, the capsula ligament will be found to be much thickened by interstitial deposits, as we as by the addition of plastic matter to its synovial lining; the head and nec of the bone are also incrusted with lymph; and the ends of the fragments a softened, unnaturally vascular, and rounded off, or partially connected b fibro-ligamentous bands. The inter-articular ligament retains its norm structure, except in rare cases, in which it is inflamed and changed int fibrous tissue.

In old cases, or such as have been on hand for some years, there are no only great thickening and induration of the capsular ligament, but extraordinary alterations in the broken bone, the neck of which is often completel annihilated, the shaft terminating abruptly on a line with the two trochanter At other times the neck is converted into a short, conical knob, partiall incrusted with cartilage, or scooped out, as it were, into a sort of cup-lik depression. The trochanters themselves are occasionally a good deal change in their appearance, especially the great, which is liable to be diminished i size and altered in configuration. The head of the bone generally retains it position in the acetabulum, but that portion of the neck which remaine attached to it at the time of the accident is usually totally absorbed; an cases occur, though they are rare, where the entire fragment is destroyed, o where it is represented by the merest possible remnant held in place by th round ligament. When the head is left, its lower surface is occasionall hollowed out into a kind of socket for the reception of the rounded conica end of the lower fragment; or the reverse obtains, the head being rounde off, and the lower fragment scooped out. In either event, the two extremities, continually moving upon each other, in time acquire a smooth, polished eburnized character, the better qualifying them for the performance of thei various functions.

The changes now described are sometimes closely imitated by those produced in the head and neck of the femur by a fall or blow on the hip, leadin to interstitial absorption of the osseous tissue, and shortening of the limb, wit destruction of the articular cartilage and eburnization of the resulting stump very much as in arthritic rheumatism. There is reason to believe that case of this kind are not unfrequently mistaken, both during life and after death for fractures of the neck of this bone. The appearances here alluded to ar well illustrated in figs. 451 and 452.

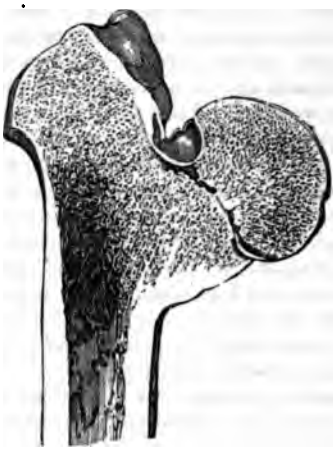
The mode of *repair* of intra-capsular fractures is peculiar, and, therefore deserving of special attention. Injuries of this description generally unit by osseous matter, which passes through the same phases as the primitiv osseous tissue, a considerable period invariably elapsing before the final completion of the process; but in this variety of fracture the connecting mediu is constantly of a fibro-ligamentous nature, similar to that which is observe in fracture of the olecranon process, the patella, and skull. But it is no always that the surgeon is to look even for such a union, imperfect as it is; in many cases the ends of the broken bone refuse altogether to unite, being gradually rounded off, and, perhaps, slightly incrusted with cartilage, or, as not unfrequently happens, especially in very aged and decrepit subjects, becoming, in time, completely absorbed, the lower fragment disappearing as far down as the two trochanters, and the upper as high up as the brim of the acetabulum. In rare cases, indeed, we see even the entire head removed, together with the greater portion both of the round and capsular ligaments.

Fig. 451.



Senile atrophy of the neck of the femur.

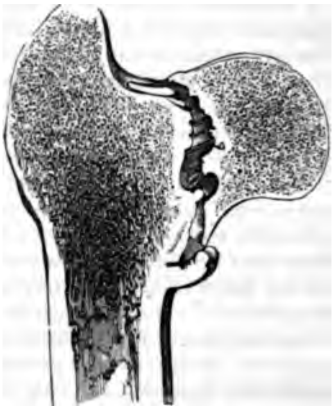
Fig. 452.



Atrophy which might be mistaken for united fracture.

A very excellent idea of the fibro-ligamentous union of this variety of fracture is afforded by fig. 453, borrowed from Sir Astley Cooper. It was taken nine months after the accident, the patient being between thirty and forty years of age.

Fig. 453.



Fracture of the neck of the thigh bone, united by fibroid matter.

The causes of this want of union are of easy recognition. In the first place, the parts have to encounter the prejudicial influence which results from the difficulty of maintaining accurate apposition of the broken ends of the bone; a circumstance which is so essential to the successful reparation of fractures in other pieces of the skeleton, but which it is almost impossible to effect here, in consequence of the want of proper leverage in the upper fragment. All the apparatus that has yet been devised for the purpose has utterly failed to accomplish the object; whatever may be done, more or less motion is inevitable. Secondly, the accident is always followed by a considerable degree of synovitis, and, as a necessary consequence, by an increased quantity of synovial fluid, which, bathing the ends of the bone, may be supposed to act inimically to the consolidating process. Thirdly, the most important reason, however, of all, why the intra-capsular fracture does not unite by osseous matter, is because the extremities of the fragments have not a sufficient amount of strength to furnish the requisite plastic and organizable deposit, their vessels and nerves being torn and destroyed at the time of the accident. The superior and smaller fragment, represented by the globular head of the bone, or the head and a little remnant of the neck, is dependent solely for its vascular and nervous supplies upon the round ligament, and every one who knows how small this ligament is, and how insignificant its vessels are in the natural state, must be aware how utterly inadequate it must be for the nourishment of the bone to which it is attached. It need not then be wondered at that there is never any show of new osseous matter on the part of this fragment. Nor does the inferior fragment fare much, if any better, in this respect. Destitute, in great measure, of fibrous covering or periosteum, with many of its vessels in a hopelessly lacerated condition, its powers are too feeble to afford any substantial aid in the process of osseous union. Hence the result must necessarily always be as above stated; that is, there will either be no reparation at all, or, if an attempt be made at establishing a connection between the two fragments, that attempt will go no farther than the formation of a fibro-ligamentous substance.

When no effort whatever at repair occurs, it is highly probable that the ends of the fragments speedily undergo the fatty degeneration, and that then they become an easy prey to the action of the absorbent vessels, eventuating in their final annihilation.

It would, perhaps, be going too far to deny altogether the possibility of bony union in intra-capsular fracture of the thigh-bone, and yet I have no hesitation in asserting that I have never seen what I could regard as an unequivocal example of the kind. I have examined most of the specimens in this country, purporting to be cases of osseous consolidation, and in no instance have the appearances been such as, in my opinion, to justify such a conclusion. In general, the history of these cases has either been so exceedingly defective, or the necroscopic characters have so closely resembled those witnessed in the changes which the head and neck of the femur undergo in consequence of old age or disease, as to destroy all confidence in their authenticity as genuine cases of intra-capsular fracture. I need not insist here upon the great difficulty which the practitioner frequently encounters in establishing a correct diagnosis in injuries about the hip; what skill and care it generally requires to discriminate accurately between a mere sprain and a fracture, or a fracture and a dislocation; or how frequently even slight lesions of the ileo-femoral articulation, and of the head and neck of the femur, are followed by changes in the structure and conformation of these portions of bone which might so closely simulate those produced by fracture as to deceive the most enlightened and cautious observer.

The question, then, in regard to the repair of intra-capsular fracture, resolves itself into four groups of facts, which may thus be stated: 1. Under favorable circumstances, both as it respects the patient and the treatment, there may be fibro-ligamentous union, answering the purpose of a sufficiently strong bond to admit of tolerable progression after recovery from the more immediate effects of the accident. 2. Under adverse circumstances, that is, when the patient is old, decrepit, or worn out by disease, and cannot, in consequence, submit to the proper treatment, or when, although the system is sufficiently vigorous, the case has been injudiciously managed, no consolidation whatever will take place, and not only so, but the neck of the bone, or both neck and head, will be absorbed, the limb remaining, of course, permanently shortened and deformed. 3. Osseous union, although perhaps not wholly impossible, is yet so exceedingly infrequent as that it cannot reasonably be looked for in any case, however propitious the circumstances attending it, both as it respects the patient and the skill and attention of his attendant. The event, other things being equal, will be most likely to happen in the impacted form of the injury, and in the ordinary fracture in comparatively young and robust persons. 4. When the fracture is of a mixed character, that is, partly within and partly without the capsular ligament, the mode of repair will be similar to that of ordinary fracture, although the process will require more time and care for its successful completion.

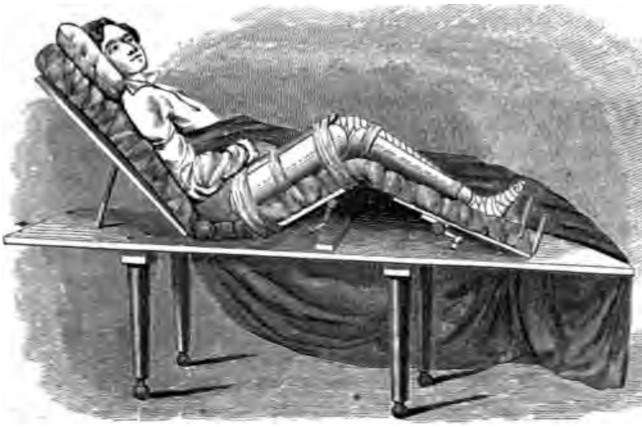
The *prognosis* in this variety of fracture is embraced in the above discussion respecting its repair, and need not, therefore, engage further attention here. In regard to life, the danger is generally inconsiderable, as the lesion is usually the result of very trivial accidents, involving no serious injury to the soft parts, or any comminution of the bone. In respect, however, to the limb, as the consolidation of the fracture is always more or less imperfect, its usefulness will necessarily be impaired in a degree proportionate to the defective character of the connecting medium. For a long time, the patient is obliged to employ a crutch, but eventually he is able to walk with the aid of a stick and a high-heeled shoe, the parts strengthening by exercise, notwithstanding there is a strong tendency to atrophy of the muscles.

Treatment.—Fractures of the neck of the femur within the capsular ligament are not, I think, generally as well managed as they should be, owing chiefly, if not wholly, to the influence of the writings of Sir Astley Cooper, who taught that, inasmuch as there never is any osseous union in this variety of injury, it was not, therefore, proper to torture the patient with a protracted confinement in the recumbent posture, and the application of an extending apparatus. He considered such a proceeding the more necessary because a great majority of the subjects of this fracture are old and decrepit persons, many of whom bear confinement very badly, soon becoming affected with foul bed-sores, and eventually perishing from hectic irritation or congestive pneumonia. In accordance with this view, he was in the habit of placing the limb upon a long pillow, in an easy position, for about a fortnight, or until the pain and inflammation, consequent upon the accident, had in a great measure subsided. The patient was then allowed to leave his bed, and sit in a high chair, or exercise upon crutches, care being taken to bear, at first, very gently upon the foot for fear of disturbing and fretting the ends of the fragments. Subsequently, as the limb improved in strength, a high-heeled shoe was ordered, and a stick was substituted for the crutches.

If this treatment were the exception, and not the rule, every practitioner of sense and experience would concur in its propriety; but the English surgeon, in his desire to generalize it, has carried it much farther than the interests of our patients justify. It is unquestionably true that many of the subjects of intra-capsular fracture do not bear confinement well; they suffer from the slightest restraint, and soon become bedridden. Such cases are extremely difficult to manage, and are not likely to be benefited by the use of splints, or any other mechanical contrivances calculated to compress the limb and hold it in an uneasy and constrained position. To this class, the treatment of Sir Astley Cooper is peculiarly applicable; indeed, no other can be employed. All that can be done is to make the patient comfortable, and let the limb get on as best it may. But there is another class of subjects, who, though perhaps a good deal advanced in years, are, nevertheless, quite stout and robust, enjoying excellent health at the time of the accident, whose constitution has never been impaired by intemperance or excess of any kind, and who can bear the long confinement incident to such an accident with the most perfect impunity. The persons composing this class are, for the most part, residents of the country, and not the poor, broken-down inhabitants of crowded cities, without any bodily vigor, and, therefore, without any recuperative power. Hence, an exclusive plan of treatment should not be adopted; on the contrary, it should be varied according to the exigencies of each particular case. Such a course is the more necessary because it is utterly impossible always to determine positively, by the most careful examination, whether the case is one purely of intra-capsular or extra-capsular fracture, or whether it partakes, as, indeed, it not unfrequently does, of the character of both, the two being conjoined.

Acting upon the above principles, I have, for many years, treated most of the cases of intra-capsular fracture that have come under my notice as any other fracture of the femur, by permanent extension and counter-extension, not with the hope, as already stated, of obtaining bony consolidation, but with the view simply of keeping the ends of the fragments more accurately in contact, and thus affording them an opportunity of becoming united by fibro-ligamentous tissue. It is obvious that such a result can only reasonably be anticipated when this condition is fully complied with. When the broken pieces are permitted to overlap each other constantly, hardly any union will be possible, certainly none of a useful kind; and there is, moreover, under such circumstances, always great risk that at least the neck, if not also the greater portion of the head of the bone, will be absorbed, and the patient, in consequence, never regain the functions of his limb. Should the treatment fail, the surgeon has the consolation to know that he has discharged his duty, by having kept the parts in the only position in which it is ever possible for them to become united in any way. The limb may be maintained in the extended position, and the apparatus which best fulfils this indication is that depicted at page 1031; or, instead of this, the limb may be placed in an easy position over a double inclined plane; or, what is better, when it can be procured, the patient may be put upon a Daniel's fracture-bed, represented in fig. 454. The latter contrivance, which, unfortunately, however, is too expensive for general private use, is particularly adapted to cases of old persons likely to require protracted confinement. The bed is so arranged that, while the patient can sit up, or vary his position, efficient extension and counter-extension may be maintained with adhesive strips. An elaborate description of the apparatus will be found in the tenth volume of the Transactions of the American Medical Association.

Fig. 454.



Daniel's fracture-bed.

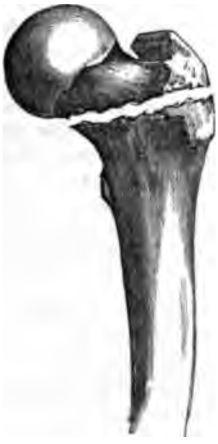
Whatever plan of treatment be adopted, its effects should be most carefully watched, so that it may not prove irksome, much less injurious. The length of time during which the patient should be confined must vary, on an average, from ten weeks to three months and a half. During all this trying period he should be on a full allowance of meat and porter; at all events, upon a generous diet, in order to sustain the system and promote reparation. Purgative medicines and all other depressing means should be used as sparingly as possible. Anodynes must be freely given in the evening to allay pain and procure sleep.

EXTRA-CAPSULAR FRACTURES.

The extra-capsular fracture is situated at the base of the neck of the femur, extending from above downwards and from behind forwards in the direction of the intertrochanteric line. It is not always, however, as the name declares, strictly exterior to the capsular ligament; on the contrary, it not unfrequently passes above the attachment of the ligament, so as to partake of the character both of an inner and an outer fracture of the neck. Moreover, the injury is always associated with fracture of the trochanters, sometimes with one, at other times with both, thus leaving in the former case three fragments, and four in the latter. Again, the fracture is often comminuted independently of its connection with the trochanters; and in the great majority of instances it is attended with more or less penetration of the superior piece into the inferior. My own observation, however, induces me to believe that, generally speaking, the penetration is very trivial, hardly ever exceeding three lines, and often not reaching even so high as that. The two accompanying cuts, figs. 455 and 456, afford a good idea of the situation and direction of the extra-capsular fracture.

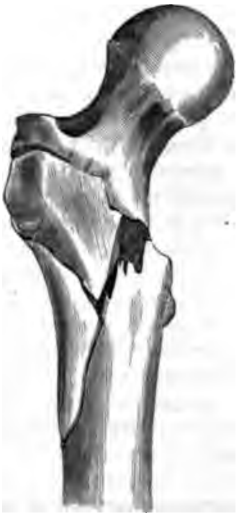
The extra-capsular fracture is not as common as the intra-capsular; the difference, however, is trivial. Men are somewhat more subject to it than women, and, while it may take place at any period of life, experience teaches that it is met with almost exclusively after the age of fifty, by far the greater number of cases occurring after the sixtieth year. It is generally supposed and, no doubt, correctly, that a much greater amount of violence is r

Fig. 455.



Extra-capsular fracture of the femur.

Fig. 456.



Comminuted fracture of the upper extremity of the femur.

to produce this fracture than the intra-capsular, but the rule admits of many exceptions. The most common exciting cause is a fall or blow upon the hip; it may also follow a fall upon the foot or knee and the passage of the wheel of a carriage across the pelvis or upper part of the limb. Finally, cases occur where it happens from the body being crushed by a heavy load descending upon the back, the lower extremities being in a fixed state at the moment of the accident. In not a few instances, however, the fracture is occasioned by very slight causes, while in most there is reason to believe that the bone where the lesion occurs is in a remarkably brittle condition, predisposing it to the disruption of its fibres. In some of the preparations that I have examined in different osteological collections the compact structure, although not very seriously diminished in thickness, was almost of a vitreous consistence, while the spongy was extremely rarefied and expanded, thus occasioning great weakness of the part. The inter-cervical portion of the bone frequently retains, under such circumstances, a remarkably healthy appearance. When the osseous tissue is so very fragile at this point, it is not improbable that it may occasionally give way under mere muscular contraction, as has happened in at least one well authenticated case, the patient, a woman, aged eighty-three, having met with the accident in an effort to preserve her equilibrium when in the act of falling.

The *symptoms* of this variety of fracture bear a strong resemblance to those of the intra-capsular, some existing in a less and others in a greater degree, but none of them, considered separately, possessing any diagnostic value. In describing these symptoms it will be most satisfactory if they be presented in the same order as in the preceding case.

The *shortening*, which is a constant occurrence, varies from half an inch to an inch, as its minimum, to an inch and a half, as its maximum. In exceptional cases it may, however, amount to two inches and upwards. It is usually most distinct when there is a badly comminuted state of the bone, or when the great trochanter, forming a part of the upper fragment, is drawn uncommonly far outwards, so as to permit the lower fragment to ride considerably over the upper. Moreover, it possesses this peculiarity, that it is generally as great immediately after the fracture as at any period afterwards.

The knee and foot are generally *everted*, the limb lying as if it were perfectly powerless, the muscles having apparently lost all influence over it. This symptom is even more striking than in the intra-capsular fracture. Eversion, however, is not so constant an occurrence as in the latter accident; in a considerable number of cases the limb is strongly rotated inwards, and in both varieties, but especially in the former, the displacement is occasionally so obstinate as to require an unusual degree of force to rectify it, depending, doubtless, upon the interlocking of the fragments.

The extra-capsular fracture is characterized by complete *mobility* of its fragments, except when they are impacted, an occurrence which, as already stated, is more common here than in fracture within the capsule. The loss of function is also complete, the patient being unable to lift the limb by the effort of his muscles, or to execute any of its natural functions.

The *crepitation* is generally very distinct, being often loud and cracking, and is readily perceived by the hand and ear, applied to the hip when the limb is rotated upon its axis. It is usually more marked than in intra-capsular fracture, and does not, as in the latter, require extension and counter-extension for its production. When the fracture is badly comminuted, the fragments may often be readily detected with the fingers, and be made to move upon each other so as to emit a grating sound not unlike that caused by rubbing together several pieces of broken china.

The position of the great *trochanter* may be the same as in the intra-capsular fracture, obeying the movements of the limb, and turning as it were upon a pivot, instead of describing the segment of a lesser circle, as it does in the natural state. In many cases, however, it is completely detached, and then, of course, it either remains stationary on rotating the foot, or it follows the inferior fragment as a separate body. In general, it will be found to be somewhat further off from the spine of the ilium than in the intra-capsular fracture, depending upon the smaller amount of retraction of the limb.

The *pain* is always unusually severe, and is greatly increased by every attempt at motion and manipulation; it is more superficial than in intra-capsular fracture, and is concentrated, as it were, upon the two trochanters.

The *swelling* is also uncommonly extensive, and there is nearly always considerable discoloration of the surface, owing to the contused and ecchymosed condition of the skin and subcutaneous cellular tissue, the latter of which is often extensively infiltrated with blood..

The *attitude* of the patient has nothing in it that is peculiar; it partakes of the same general character as that which is met with in intra-capsular fracture, and, in fact, so closely simulates it as to be distinguished from it with difficulty.

Finally, along with the symptoms now described, there is generally, in extra-capsular fracture, evidence of severe shock immediately after the occurrence of the accident, and the resulting reaction is not unfrequently followed by high fever, lasting often for a number of days, and requiring great attention on the part of the professional attendant. In intra-capsular fracture the patient may feel very faint, but he soon recovers, and seldom has much constitutional disturbance afterwards.

The *reparation* of the extra-capsular fracture is effected in the same manner precisely as fracture of any other piece of the skeleton provided with periosteum. It differs, therefore, wholly, in this respect, from that of the intra-capsular form of the lesion. Here osseous union is the rule, the want of it the exception, the reverse being the case in intra-capsular fracture. The period at which the consolidation will be completed will, of course, depend, as a general rule, upon the age and health of the patient, the presence or absence of complications, and, above all, upon the care which is observed in keeping the ends of the fragments in accurate apposition.

Although the extra-capsular fracture invariably unites by osseous matter, yet the *prognosis* is very far from being always favorable either as it respects the possibility of avoiding deformity and lameness, or our ability to save the patient. When the fracture is comminuted, or the bone is broken into a number of pieces, including the two trochanters, a good result is hardly to be anticipated under the most judicious management that the case can receive. Under such circumstances the neck of the bone, having lost its support, is pushed downwards and inwards below its natural level, and the consequence is that a certain degree of shortening with deformity of the upper part of the thigh will be inevitable. The same result will necessarily follow when the fracture is impacted. These facts should be well studied and appreciated, and should always be promptly communicated to the patient, lest, when the cure is completed, he might blame his attendant for making him a bad limb when it was impossible to make a good one.

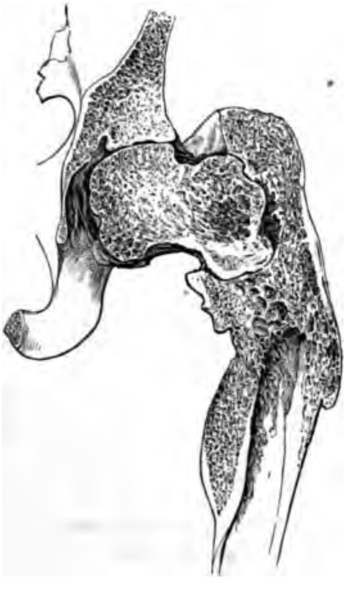
From the great violence that is so frequently inflicted upon the parts, both soft and hard, the extra-capsular fracture often proves hazardous both to limb and life. Occasionally, though rarely, the patient dies from shock; in some instances he suffers greatly from the effects of excessive reaction. Most generally, however, when there is danger, life is put in jeopardy by the supervention of erysipelas, or pyemia, the former commonly setting in within the first forty-eight hours from the occurrence of the fracture, and the latter towards the end of the first week or the beginning of the second. Some idea of the danger of extra-capsular fracture may be formed when it is stated that of eighteen cases treated in the Richmond Hospital at Dublin, nine proved fatal, the period of death ranging from the fifth to the fifteenth day. In some cases the patient sinks from the exhaustion consequent upon extensive suppuration or the formation of large sloughs over the sacrum and buttocks from protracted confinement in one position.

The *treatment* of extra-capsular fracture differs in no wise from that which is necessary in fracture of the shaft of the bone. The limb, being placed in the straight position, is kept perfectly at rest by means of splints, stretched along its outer and inner surfaces, and connected below in such a manner as to admit of the requisite extension and counter-extension until a cure is effected. The foot should incline *slightly* outwards to favor relaxation of the external rotator muscles, and special care should be taken to prevent overlapping of the fragments, or angular deformity, by the use of a gutta-percha splint, accurately moulded to the outer and anterior part of the thigh, and well secured by the bandage. The dressing should be continued for at least five weeks.

IMPACTED FRACTURES OF THE NECK OF THE FEMUR.

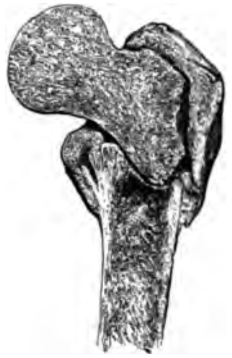
Fracture of the neck of the femur occasionally presents itself as an impacted lesion, the lower extremity of the upper fragment being forcibly impelled into the cancellated structure of the upper end of the lower fragment, the great trochanter being usually carried along with the descending portion. The accident, which is sufficiently rare, and of which fig. 457, from a specimen in the Mütter collection, affords a beautiful illustration, is nearly always associated with extra-capsular fracture, and occurs under two varieties of form, the complete and incomplete, of which the latter is by far the more frequent. Old persons only are subject to it, and it is most common in those in whom the neck of the femur is of inordinate volume in consequence of the expansion of its spongy structure. The line of fracture is generally at the base of the neck, or at the junction of the neck with the shaft, the penetration occurring in the direction of the anterior surface of the bone, with which the neck is more immediately continuous, being separated from it behind by a well-marked depression, and by the large ridge connecting the two trochanters. The fracture

Fig. 457.



Impacted fracture of the neck of the femur.

Fig. 458.



Impacted fracture, through the trochanters, the upper fragment being wedged into the lower.

usually happens from the body being crushed by the falling of a heavy substance upon the trunk, while the chest is inclined forwards, and the knee rests upon a solid surface, the hip at the same time receiving a severe blow, as when a person is buried by the caving in of a coal bank; or, it may be produced by a fall from a height upon the knee, in which the weight of the body is violently impelled in the opposite direction, the two forces continuing to act after the bony tissues have given way. The direction of the fracture is generally oblique, extending from above downwards, from the great to the small trochanter, both of which are not unfrequently included in the injury, as seen in fig. 458.

The distance at which the upper fragment is buried in the lower varies from a few lines to half an inch, three-quarters of an inch, or even an inch, depending upon the degree of the impelling force and the amount of expansion of the cancellated structure at the base of the cervix. The compact substance of both fragments is often extensively comminuted, and the fragments themselves are usually interlocked in such a manner as to give the thigh-bone the appearance of being twisted upon its axis, the limb after the accident being generally everted, as in fracture without impaction, though in a less marked degree.

There is a variety of impacted fracture of the neck of the femur in which the lower fragment is impelled into the reticulated structure of the upper. The occurrence is very rare, and the amount of shortening a good deal less than in the more common form of the injury.

The *symptoms* of impacted fracture of the neck of the femur are in general quite characteristic, though a good deal of care is necessary, in every case, in order to make a correct diagnosis. The most valuable and reliable phenomena are the shortening of the thigh, eversion of the foot, the ability of the patient to walk, or to bear the weight of the body upon the thigh, after the accident, and the resistance which the fragments offer to extension and counter-extension when an attempt is made to restore the limb to its natural position. The pain is usually very intense, generally much more so than in ordinary cervical fracture, and there is not unfrequently extensive ecchymosis over the great trochanter, causing unwonted swelling and discoloration.

The degree of shortening varies, as already stated, from a few lines to an inch or more, the average ranging from a quarter of an inch to half an inch, which it rarely exceeds. The eversion of the foot, although well marked, generally exists in a slighter degree than in fracture of the neck of the bone without penetration, whether the injury be seated on the outside or within the capsular ligament. The occurrence is the more valuable as a diagnostic from the fact that it is rarely, if ever, entirely absent. Owing to the fact that the continuity of the femur is preserved, the patient is generally able to walk after the accident, although not without much suffering, or, at all events, to bear the weight of his body upon the affected member. For the same reason, the limb is easily rotated upon its axis, bent upon the pelvis, extended, abducted, or adducted; and when an attempt is made to restore it to its normal length, the effort, unless very powerful, ordinarily fails, the ends of the fragments retaining their interlocked position, despite the extension and counter-extension. Finally, there is generally, in addition to the symptoms now described, more or less deformity, although this cannot always be easily detected on account of the excessive swelling, and, when present, is not, of course, characteristic.

What, then, are the most important phenomena in a diagnostic point of view? Beyond all doubt the shortening of the thigh, the immobility of the limb, the existence of deformity at the hip, in the situation of the great trochanter, and the absence of crepitation. When these signs are present, it may be assumed that there is no dislocation of the ileo-femoral joint, nor any ordinary fracture of the neck of the femur, but fracture of this portion of the bone with impaction of the upper fragment.

The *prognosis* of this variety of fracture is much more favorable than that of ordinary fracture of the cervix; for inasmuch as the fragments are firmly wedged together, it usually requires but little callus to effect their consolidation. Besides, very little retentive apparatus is usually necessary, the two fragments serving as their own splints. On the other hand, however, there must always remain a certain degree of deformity, consisting of slight shortening of the limb, and of an incurvated state of the thigh just below the hip. Some permanent lameness may, therefore, reasonably be looked for after the accident, even under the most favorable circumstances. I have seen several specimens of impacted fracture of the neck of the femur where great and irremediable anchylosis was produced by osseous matter being extended, in the form of bridges, from the seat of the injury to the innominate bone, immediately around the acetabulum, connecting the two together in a solid mass.

These protective means are displayed in a remarkable manner in a specimen, above depicted, of impacted fracture of the neck of the left femur in the Mütter collection. The head and neck of the bone, being two inches and nearly three-quarters in length, occupy a horizontal position in regard to the shaft, the neck being driven into the cancellated structure of the latter some distance below the trochanters. The superior third, or more, of the shaft is bent strongly forwards and outwards, and is surrounded by a casing of new osseous matter, more than half an inch in thickness at the concavity of the curve, or weakest portion of the femur, and at a point, consequently, where, after such an accident, the greatest amount of support is required. A large ledge of bone, two inches long, and very broad, thick, and firm, projects from the anterior and inner aspect of the superior extremity over towards the hip-joint, being connected by a strong, round ligament, upwards of two inches in length, with the anterior inferior spinous process of the ilium, which juts out as a remarkably long, slender prominence, more than twice the normal size. An idea of the amount of shortening of the femur may be formed, when it is stated that the summit of the great trochanter projected fully one inch above the upper border of the acetabulum. Nothing is known of the history of the case; but, judging from the completeness of the reparation, the accident must have occurred many years before death. Some degree of motion, certainly very slight, must have existed both in the acetabulum and at the junction of the two fragments, the upper end of the lower of which was converted into a socket into which the lower end of the upper was received, a kind of adventitious membrane having been interposed between the contiguous surfaces.

In the *treatment* of this fracture, one important point is not to pull the ends of the broken bone asunder in our attempts to examine the case. Hence, whenever impaction is suspected, the rule is to refrain from all rotation and extension. The nature of the accident being properly diagnosticated, the limb is to be placed in an easy position in bed, a pillow lying under the ham, and gentle, but steady pressure being made, by means of a compress and bandage, in the direction of the great trochanter, with a view of rectifying any deformity that may exist in that situation. Generally, no splint will be required, and in ordinary cases the patient will be able to move about on crutches in three or four weeks.

General Diagnosis.—Fractures of the neck of the thigh-bone are liable to be mistaken for other lesions, and it becomes, therefore, a matter of importance to the practitioner to have accurate conceptions of their real nature, errors of diagnosis here being always particularly prejudicial, both to the patient and the practitioner. The affections with which they are most apt to be confounded are sprains and dislocations of the hip-joint, and, in many cases, great difficulty is also experienced in deciding whether the injury is one of fracture within the capsular ligament, or of fracture exterior to it.

The symptoms of fracture of the neck of the femur, especially the intracapsular, are sometimes closely simulated by sprains and contusions of the hip, causing involuntary obliquity of the pelvis with apparent shortening of the limb, and eversion of the knee and foot, along with excessive pain and difficulty of motion. The resemblance is occasionally so perplexing as to create doubt in the mind of the most skilful diagnostician, and, among the less informed, has often led to the most serious errors of practice, by the employment of harsh means when the most mild and soothing alone were necessary. The signs of distinction are the following: 1. In fracture the shortening is real, and can be effaced only by extension and counter-extension; in sprains and contusions, on the contrary, it is not real, but apparent, as may be proved by placing the limbs parallel with each other, and bringing the two iliac crests on the same level. 2. In fracture the eversion of the foot is complete, the extremity presenting an appearance characteristic of total loss of power; in ordinary injuries of the hip and upper part of the thigh, the eversion is comparatively slight, and the patient can, in general, rectify it by his own efforts, although they may be productive of severe distress. 3. In fracture there is usually complete abolition of muscular action; so that the thigh can neither be flexed, extended, nor rotated, however determined the attempt. It is only in the impacted fracture that the individual has still some control over the limb, and then the best guide for avoiding mistake is the existence of actual shortening. In sprains and contusions motion is diminished, perhaps very greatly, but not abolished.

One would suppose, at first sight, that it would be very difficult, even for an experienced practitioner, to mistake a fracture of the neck of the thigh-bones for a dislocation of its head upon the dorsal surface of the ilium, yet numerous cases are upon record testifying not only to the possibility of such an accident, but to its actual occurrence in the hands of distinguished surgeons. The only way to avoid error is to remember clearly the most prominent signs of each lesion. The subjoined tabular arrangement will serve to place the subject in its proper light, at the same time rendering a comparison of these symptoms an easy task:—

Intra-capsular Fracture.	Iliac Dislocation.
1. Occurs nearly always in old persons.	1. Is most common in adult and middle life.
2. Is most common in women.	2. Occurs with equal frequency in both sexes.
3. Usually the result of slight causes.	3. Always produced by severe force.
4. The foot is strongly everted.	4. The foot is inverted.
5. There is great shortening, readily effaceable by extension and counter-extension, but recurring the moment the force is discontinued.	5. The shortening is also great, but can be effaced only by restoring the bone to its natural position, when it will not return.
6. Marked crepitation exists.	6. There is no crepitation.
7. There is preternatural mobility, the ends of the fragments being movable upon each other.	7. The bone is in a fixed and constrained position.

But the greatest difficulty in the diagnosis of these affections of the thigh and hip arises from the embarrassment which the surgeon experiences in determining whether the case be one of intra-capsular fracture, or fracture exterior to the capsular ligament. As the subject is one of great practical consequence, it deserves to be studied with unusual care; and I shall, therefore, arrange the principal points in tabular form:—

INTRA-CAPSULAR FRACTURE.	EXTRA-CAPSULAR FRACTURE.
1. The shortening, slight at first, generally not exceeding a third or half an inch, gradually increases to two inches and upwards.	1. The shortening is as great immediately after the accident as it is at any time afterwards, and its extent also is usually less than in the intra-capsular fracture.
2. The crepitation is indistinct, and can only be fully elicited by extension and counter-extension.	2. Crepitation is uncommonly distinct, being often loud and ringing, and is readily perceived on laying the hand on the trochanter and rotating the limb.
3. Function is much impaired, but not wholly abolished.	3. The loss of power is complete, the limb lying in a helpless, paralyzed condition.
4. The great trochanter, on rotating the limb, moves, as it were, upon a pivot.	4. The great trochanter is often partially separated from the shaft of the bone, and then but imperfectly obeys the movements of the limb.
5. The pain is unreliable, both as it respects site and intensity, being generally most severe at the upper and inner part of the thigh, in the direction of the small trochanter.	5. Pain is unreliable, but generally very severe, especially on manipulation or motion, and seated more in the direction of the great trochanter.
6. There is generally little or no contusion, swelling, or discoloration.	6. Usually severe contusion, with considerable swelling, ecchymosis, and discoloration.

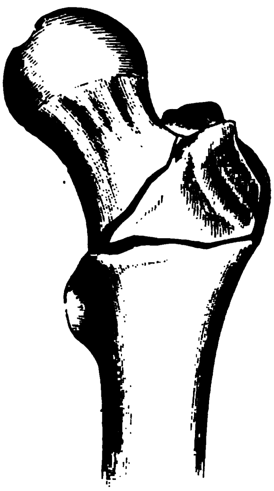
Nothing of any diagnostic value can be deduced from a consideration of the age at which these two fractures occur, since, as was previously stated, both are met with almost exclusively after the fiftieth year, there being only a few well authenticated cases on record of its occurrence prior to that period. The same is true in relation to sex, experience having shown that this exercises much less influence upon the production of these two varieties of fracture than was formerly imagined. I am inclined, from a careful study of the subject, to place more reliance, in this respect, upon the existence of severe external injury, as contusion, swelling, and ecchymosis, and upon the presence of shortening, than upon any other phenomena. In the intra-capsular fracture, the external signs of injury are certainly, as a general rule, exceedingly slight, while the reverse is usually the case in the extra-capsular, the parts being nearly always much bruised and discolored. In regard to shortening, it possesses, I think, great value as a diagnostic of the two lesions; for it may be assumed, on the one hand, that when it is very slight immediately after the receipt of the injury, and gradually increases afterwards, it depends upon intra-capsular fracture; and, on the other, that when it is very considerable immediately after the accident, it is caused by extra-capsular fracture. Rodet, who studied the subject with much attention, arrived at the conclusion that every fracture of the neck of the femur, produced by a fall or blow upon the great trochanter, was of an extra-capsular nature; whereas, every one occasioned by a fall upon the feet, or by muscular action, must be seated within the ligament. This conclusion, however, is altogether unfounded; in adopting it we should be compelled to assume that all intra-capsular fractures are the result of falls upon the feet, when all experience teaches that they are almost invariably produced by force applied directly to the hip.

The most important diagnostic characters of the *impacted* fracture of the neck of the femur, whether within or without the capsule, are, as has already been stated, shortening of the limb, the absence of crepitation, and the comparative or complete immobility of the fragments. The shortening is always immediate, and remains permanent in its original degree, unless the ends of the bone are rudely drawn asunder; hence it is a sign of an unequivocal character; the absence of crepitus is also very significant, and the trivial mobility, or complete absence of motion, is another circumstance of importance. The great danger in such a case is that the fracture may be mistaken for a dislocation; but from this it may usually be readily distinguished by careful study of its history, and a thorough examination and comparison of the symptoms characteristic of the two lesions.

FRACTURES OF THE GREAT TROCHANTER.

Fracture of this bony apophysis may take place as an independent lesion, or as a concomitant of fracture of the neck of the femur, outside of the capsular ligament, as mentioned previously, and as exhibited in fig. 459, from a specimen in my collection. As an independent fracture, it is very infrequent in comparison with the other variety. It may occur at any period of life, but is chiefly observed in elderly subjects, as a consequence of direct violence, as a fall, blow, or kick, breaking off the trochanter in an oblique direction from above downwards. The fracture is sometimes comminuted, the trochanter being broken into several pieces, of irregular size and shape, the fragments grating under the fingers like a number of pieces of china. It may also be compound, although, in general, it is unaccompanied by any wound of the soft parts.

Fig. 459.



Fracture of the great trochanter.

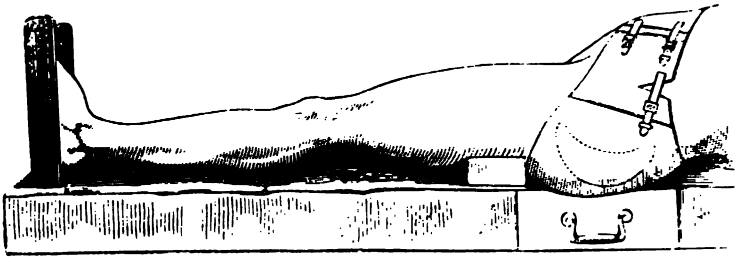
The *symptoms* of fracture of the great trochanter are generally well marked, the most important consisting in eversion of the limb, with separation of the fragments, inability on the part of the patient to sit down, and difficulty of obtaining crepitation. The eversion is unusually distinct, and is probably due, at least in great degree, to the loss of power in the external rotator muscles; the limb lies in a helpless condition, and no effort that the patient can make can change its position. The broken trochanter is commonly widely separated from the shaft of the bone, and hence the difficulty which is generally experienced in eliciting crepitus, this being only practicable by placing the parts in apposition with each other. The displacement is either upwards towards the ilium, or downwards towards the tuberosity of the ischium, the former being the more frequent. When the patient attempts to sit down he is completely foiled, and immediately experiences great increase of pain, compelling him to desist. Most authors speak of shortening of the limb as a symptom of this fracture, but, if shortening really exist, it can only be in a very slight degree. More or less contusion and ecchymosis of the soft parts are usually present.

The *diagnostic* signs are the eversion of the limb, the loss of prominence at the natural site of the trochanter, the fixed position of the small fragment on moving the shaft of the femur, and crepitus on approximation of the broken ends.

The *union* of this fracture is by osseous matter, and, unless the bone is comminuted, a cure may reasonably be expected without any deformity of the hip or impairment of the functions of the limb. Considerable difficulty, however, is generally experienced in maintaining apposition of the fragments, and hence such an injury always requires more than ordinary vigilance on the part of the attendant.

The *treatment* consists in maintaining the limb in a perfect state of quietude by means of two long splints, the foot being supported in a perpendicular direction, with a slight tendency to eversion, which is the most natural position for a person when he lies on his back, and, therefore, the most eligible *for relaxing the* external rotator muscles when there is a fracture of the trochanter. The broken trochanter, being drawn into its natural situation, is confined there by a soft leather belt, long enough to extend round the pelvis, and furnished with a sort of hollow pad, from three to four inches in diameter, for the purpose of embracing more effectually the prominence of the hip. Hardly any extension will be necessary. If the soft parts are much contused, leeches and fomentations should be applied before putting on the permanent dressings. After the patient has been confined for a month, he may be permitted to exercise on crutches. The annexed cut, fig. 460, represents the mode of treating fractures of the great trochanter, recommended by Sir Astley Cooper.

Fig. 460.



Sir Astley Cooper's mode of treating fractures of the great trochanter.

The great trochanter is occasionally detached from the neck and shaft of the femur, in consequence of the forcible laceration of the fibro-cartilage by which it is connected to these parts during its *epiphysary* state in early life, before the completion of the process of ossification. The accident, which is one of uncommon occurrence, is usually produced by a severe fall upon the hip, and is always extremely difficult of diagnosis, owing to the fact that there is seldom much, if any, appreciable displacement. In most of the recorded cases there has been much diversity in the symptoms; in some, the patient was able to walk immediately after the accident, while in others he had lost all control over the muscles of his limb; in some, the foot was everted, while in others it preserved its natural position, or was even inverted; in all there was severe pain, with considerable swelling, either alone or conjoined with ecchymosis, at the site of injury, and, during their progress, more or less constitutional disturbance.

The best manner of determining the diagnosis, in this accident, is to make the patient lie on his back and incline the pelvis over the injured side, while the affected limb is thoroughly abducted, or carried away from the sound one. The gluteo-femoral muscles being thus completely relaxed, the trochanter, if detached, may easily be pushed into its natural position, and crepitation elicited by rubbing it against the neck and shaft of the femur.

The occurrence of this accident is not without danger, several cases having been recorded in which it proved fatal, death having been caused by extensive suppuration and constitutional disturbance. When recovery takes place, the limb remains for a long time weak and painful. The union, under such circumstances, is fibro-cartilaginous, or partly cartilaginous and partly osseous. The treatment must be conducted upon the same principles as in ordinary fracture of the trochanter.

END OF VOL. I.

BLANCHARD & LEA'S
MEDICAL AND SURGICAL PUBLICATIONS.

TO THE MEDICAL PROFESSION.

The greatly enhanced cost of materials and labor has at length obliged us to make a small increase in the price of some of our books, and we have been forced in a few instances to change the style of binding from leather to cloth, in consequence of the increased difficulty of procuring a full supply of the superior quality of leather which we require for our publications. We have made these changes with reluctance, and can only hope that we may not be forced to further modifications by a continued increase of cost.

BLANCHARD & LEA.

PHILADELPHIA, September, 1863.

⁂ We have recently issued an ILLUSTRATED CATALOGUE of Medical and Scientific Publications, forming an octavo pamphlet of 80 large pages, containing specimens of illustrations, notices of the medical press, &c. &c. It has been prepared without regard to expense, and will be found one of the handsomest specimens of typographical execution as yet presented in this country. Copies will be sent to any address, by mail, free of postage, on receipt of nine cents in stamps.

Catalogues of our numerous publications in miscellaneous and educational literature forwarded on application.

☞ The attention of physicians is especially solicited to the following important new works and new editions, just issued or nearly ready:—

Bowman's Medical Chemistry, a new edition,	See page	4
Barclay on Medical Diagnosis, second edition,	"	5
Brande and Taylor's Chemistry,	"	6
Dalton's Human Physiology, 2d edition,	"	11
Dunglison's Medical Dictionary, a revised edition,	"	12
Erichsen's System of Surgery, a revised edition,	"	14
Flint on the Heart,	"	14
Gross's System of Surgery, second edition,	"	16
Gray's Anatomy, Descriptive and Surgical, 2d edition,	"	17
Hamilton on Fractures and Dislocations, second edition,	"	18
Hodge on Diseases of Women,	"	19
Meigs' Obstetrics, fourth edition,	"	21
Parrish's Practical Pharmacy, a new edition,	"	25
Stillé's Therapeutics and Materia Medica,	"	27
Simpson on Diseases of Women,	"	27
Sargent's Minor Surgery, new edition,	"	28
Watson's Practice of Physic,	"	30
Wilson on the Skin, fifth edition,	"	31
West on Diseases of Women, second edition,	"	32

NO INCREASE OF PRICE.

TWO MEDICAL PERIODICALS, FREE OF POSTAGE,

Containing about Fifteen Hundred large octavo pages,

FOR FIVE DOLLARS PER ANNUM.

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, subject to postage, when not paid for in advance, - - - - - - - - - $5 00

THE MEDICAL NEWS AND LIBRARY, invariably in advance, - - 1 00

or, BOTH PERIODICALS mailed, FREE OF POSTAGE (as long as the existing rates are maintained), to any post-office in the United States, for Five Dollars remitted in advance.

It will be observed that notwithstanding the great increase in the cost of production, the subscrip tion price has been maintained at the former very moderate rate, which has long rendered thei among the

CHEAPEST OF AMERICAN MEDICAL PERIODICALS.

The publishers trust that this course will be responded to by the profession in a liberal increas to the subscription list.

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES,

EDITED BY ISAAC HAYS, M. D.,

is published Quarterly, on the first of January, April, July, and October. Each number contai about two hundred and eighty large octavo pages, handsomely and appropriately illustrate wherever necessary. It has now been issued regularly for more than FORTY years, and it has bee under the control of the present editor for more than a quarter of a century. Throughout th long period, it has maintained its position in the highest rank of medical periodicals both at hom and abroad, and has received the cordial support of the entire profession in this country. Its list Collaborators will be found to contain a large number of the most distinguished names of the pr fession in every section of the United States, rendering the department devoted to

ORIGINAL COMMUNICATIONS

full of varied and important matter, of great interest to all practitioners.

As the aim of the Journal, however, is to combine the advantages presented by all the differe varieties of periodicals, in its

REVIEW DEPARTMENT

will be found extended and impartial reviews of all important new works, presenting subjects novelty and interest, together with very numerous

BIBLIOGRAPHICAL NOTICES,

including nearly all the medical publications of the day, both in this country and Great Britain, wi a choice selection of the more important continental works. This is followed by the

QUARTERLY SUMMARY,

being a very full and complete abstract, methodically arranged, of the

IMPROVEMENTS AND DISCOVERIES IN THE MEDICAL SCIENCES.

This department of the Journal, so important to the practising physician, is the object of especi care on the part of the editor. It is classified and arranged under different heads, thus facilitati the researches of the reader in pursuit of particular subjects, and will be found to present a ve full and accurate digest of all observations, discoveries, and inventions recorded in every branch medical science. The very extensive arrangements of the publishers are such as to afford to th editor complete materials for this purpose, as he not only regularly receives

ALL THE AMERICAN MEDICAL AND SCIENTIFIC PERIODICALS,

but also twenty or thirty of the more important Journals issued in Great Britain and on the Cont nent, thus enabling him to present in a convenient compass a thorough and complete abstract everything interesting or important to the physician occurring in any part of the civilized world.

To their old subscribers, many of whom have been on their list for twenty or thirty years, th publishers feel that no promises for the future are necessary; but those who may desire for th first time to subscribe, can rest assured that no exertion will be spared to maintain the Journal i the high position which it has occupied for so long a period.

By reference to the terms it will be seen that, in addition to this large amount of valuable an practical information on every branch of medical science, the subscriber, by paying in advanc becomes entitled, without further charge, to

THE MEDICAL NEWS AND LIBRARY,

a monthly periodical of thirty-two large octavo pages. Its "NEWS DEPARTMENT" presents th current information of the day, while the "LIBRARY DEPARTMENT" is devoted to presenting stan ard works on various branches of medicine. Within a few years, subscribers have thus receive without expense many works of the highest character and practical value, such as "Watson' Practice," "Todd and Bowman's Physiology," "Malgaigne's Surgery," "West on Children. "West on Females, Part I.," "Habershon on the Alimentary Canal," "Simpson on Females, &c

While the work at present appearing in its columns, commencing January 1, 1863, is

ASTHMA; ITS PATHOLOGY, CAUSES, CONSEQUENCES, AND TREATMENT.

BY H. H. SALTER, M. D., F. R. S., &c.

This work, the result of much experience in the management of a common and exceedingly in tractable disease, can hardly fail to give satisfaction to subscribers, and to maintain the practica character of the valuable series of books which have appeared in the pages of the "NEWS."

It will thus be seen that for the small sum of FIVE DOLLARS, paid in advance, the subscribe will obtain a Quarterly and a Monthly periodical,

EMBRACING ABOUT FIFTEEN HUNDRED LARGE OCTAVO PAGES.

Those subscribers who do not pay in advance will bear in mind that their subscription of Fiv Dollars will entitle them to the Journal only, without the News, and that they will be at the expens of their own postage on the receipt of each number. The advantage of a remittance when order ing the Journal will thus be apparent.

Remittances of subscriptions can be mailed at our risk, when a certificate is taken from the Post master that the money is duly inclosed and forwarded.

Address BLANCHARD & LEA, PHILADELPHIA.

ASHTON (T. J.),

Surgeon to the Blenheim Dispensary, &c.

ON THE DISEASES, INJURIES, AND MALFORMATIONS OF THE RECTUM AND ANUS; with remarks on Habitual Constipation. From the third and enlarged London edition. With handsome illustrations. In one very beautifully printed octavo volume, of about 300 pages, extra cloth. $2 00.

The most complete one we possess on the subject.—*Medico-Chirurgical Review.*

We are satisfied, after a careful examination of the volume, and a comparison of its contents with those of its leading predecessors and contemporaries, that the best way for the reader to avail himself of the excellent advice given in the concluding paragraph above, would be to provide himself with a copy of the book from which it has been taken, and diligently to con its instructive pages. They may secure to him many a triumph and fervent blessing.—*Am. Journal Med. Sciences.*

ALLEN (J. M.), M. D.,

Professor of Anatomy in the Pennsylvania Medical College, &c.

THE PRACTICAL ANATOMIST; or, The Student's Guide in the Dissecting-ROOM. With 266 illustrations. In one handsome royal 12mo. volume, of over 600 pages, extra cloth. $2 25.

We believe it to be one of the most useful works upon the subject ever written. It is handsomely illustrated, well printed, and will be found of convenient size for use in the dissecting-room.—*Med. Examiner.*

However valuable may be the "Dissector's Guides" which we, of late, have had occasion to notice, we feel confident that the work of Dr. Allen is superior to any of them. We believe with the author, that none is so fully illustrated as this, and the arrangement of the work is such as to facilitate the labors of the student. We most cordially recommend it to their attention.—*Western Lancet.*

ANATOMICAL ATLAS.

By Professors H. H. Smith and W. E. Horner. of the University of Pennsylvania. 1 vol. 8vo., extra cloth, with nearly 650 illustrations. ☞ See Smith, p. 26.

ABEL (F. A.), F. C. S. AND C. L. BLOXAM.

HANDBOOK OF CHEMISTRY, Theoretical, Practical, and Technical; with a Recommendatory Preface by Dr. Hofmann. In one large octavo volume, extra cloth, of 662 pages, with illustrations.. $3 25.

ASHWELL (SAMUEL), M. D.,

Obstetric Physician and Lecturer to Guy's Hospital, London.

A PRACTICAL TREATISE ON THE DISEASES PECULIAR TO WOMEN. Illustrated by Cases derived from Hospital and Private Practice. Third American, from the Third and revised London edition. In one octavo volume, extra cloth, of 528 pages. $3 00.

The most useful practical work on the subject in the English language.—*Boston Med. and Surg. Journal.*

The most able, and certainly the most standard and practical, work on female diseases that we have yet seen.—*Medico-Chirurgical Review.*

ARNOTT (NEILL), M. D.

ELEMENTS OF PHYSICS; or Natural Philosophy, General and Medical. Written for universal use, in plain or non-technical language. A new edition, by Isaac Hays, M. D. Complete in one octavo volume, leather, of 484 pages, with about two hundred illustrations. $2 50.

BIRD (GOLDING), A. M., M. D., &c.

URINARY DEPOSITS: THEIR DIAGNOSIS, PATHOLOGY, AND THERAPEUTICAL INDICATIONS. Edited by Edmund Lloyd Birkett, M. D. A new American, from the last and enlarged London edition. With eighty illustrations on wood. In one handsome octavo volume, of about 400 pages, extra cloth. $2 75. (*Just Ready.*)

It can scarcely be necessary for us to say anything of the merits of this well-known Treatise, which so admirably brings into practical application the results of those microscopical and chemical researches regarding the physiology and pathology of the urinary secretion, which have contributed so much to the increase of our diagnostic powers, and to the extension and satisfactory employment of our therapeutic resources. In the preparation of this new edition of his work, it is obvious that Dr. Golding Bird has spared no pains to render it a faithful representation of the present state of scientific knowledge on the subject it embraces.—*British and Foreign Med.-Chir. Review.*

BENNETT (J. HUGHES), M. D., F. R. S. E.,

Professor of Clinical Medicine in the University of Edinburgh, &c.

THE PATHOLOGY AND TREATMENT OF PULMONARY TUBERCULOSIS, and on the Local Medication of Pharyngeal and Laryngeal Diseases frequently mistaken for or associated with, Phthisis. One vol. 8vo.,extra cloth, with wood-cuts. pp. 130. $1 25.

BARLOW (GEORGE H.), M. D.

Physician to Guy's Hospital, London, &c.

A MANUAL OF THE PRACTICE OF MEDICINE. With Additions by D. F. Condie, M. D., author of "A Practical Treatise on Diseases of Children," &c. In one handsome octavo volume, extra cloth, of over 600 pages. $2 75.

We recommend Dr. Barlow's Manual in the warmest manner as a most valuable vade-mecum. We have had frequent occasion to consult it, and have found it clear, concise, practical, and sound.—*Boston Med. and Surg. Journal.*

BUDD (GEORGE), M. D., F. R. S.,

Professor of Medicine in King's College, London.

ON DISEASES OF THE LIVER. Third American, from the third and enlarged London edition. In one very handsome octavo volume, extra cloth, with four beautifully colored plates, and numerous wood-cuts. pp. 500. $3 00.

Has fairly established for itself a place among the classical medical literature of England.—*British and Foreign Medico-Chir. Review.*

Dr. Budd's Treatise on Diseases of the Liver is now a standard work in Medical literature, and during the intervals which have elapsed between the successive editions, the author has incorporated into the text the most striking novelties which have characterized the recent progress of hepatic physiology and pathology: so that although the size of the book is not perceptibly changed, the history of liver diseases is made more complete, and is kept upon a level with the progress of modern science. It is the best work on Diseases of the Liver in any language.—*London Med. Times and Gazette.*

BUCKNILL (J. C.), M. D., AND DANIEL H. TUKE, M. D.,

Medical Superintendent of the Devon Lunatic Asylum. Visiting Medical Officer to the York Retreat.

A MANUAL OF PSYCHOLOGICAL MEDICINE; containing the History, Nosology, Description, Statistics, Diagnosis, Pathology, and Treatment of INSANITY. With a Plate. In one handsome octavo volume, of 536 pages, extra cloth. $3 00.

The increase of mental disease in its various forms, and the difficult questions to which it is constantly giving rise, render the subject one of daily enhanced interest, requiring on the part of the physician a constantly greater familiarity with this, the most perplexing branch of his profession. At the same time there has been for some years no work accessible in this country, presenting the results of recent investigations in the Diagnosis and Prognosis of Insanity, and the greatly improved methods of treatment which have done so much in alleviating the condition or restoring the health of the insane. To fill this vacancy the publishers present this volume, assured that the distinguished reputation and experience of the authors will entitle it at once to the confidence of both student and practitioner. Its scope may be gathered from the declaration of the authors that "their aim has been to supply a text book which may serve as a guide in the acquisition of such knowledge, sufficiently elementary to be adapted to the wants of the student, and sufficiently modern in its views and explicit in its teaching to suffice for the demands of the practitioner."

BENNETT (HENRY), M. D.

A PRACTICAL TREATISE ON INFLAMMATION OF THE UTERUS, ITS CERVIX AND APPENDAGES, and on its connection with Uterine Disease. To which is added, a Review of the present state of Uterine Pathology. Fifth American, from the third English edition. In one octavo volume, of about 500 pages, extra cloth. $2 00.

BROWN (ISAAC BAKER),

Surgeon-Accoucheur to St. Mary's Hospital, &c.

ON SOME DISEASES OF WOMEN ADMITTING OF SURGICAL TREATMENT. With handsome illustrations. One vol. 8vo., extra cloth, pp. 276. $1 60.

Mr. Brown has earned for himself a high reputation in the operative treatment of sundry diseases and injuries to which females are peculiarly subject. We can truly say of his work that it is an important addition to obstetrical literature. The operative suggestions and contrivances which Mr. Brown describes, exhibit much practical sagacity and skill, and merit the careful attention of every surgeon-accoucheur.—*Association Journal.*

We have no hesitation in recommending this book to the careful attention of all surgeons who make female complaints a part of their study and practice.—*Dublin Quarterly Journal.*

BOWMAN (JOHN E.), M. D.

PRACTICAL HANDBOOK OF MEDICAL CHEMISTRY. Edited by C. L. Bloxam. Third American, from the fourth and revised English Edition. In one neat volume, royal 12mo., extra cloth with numerous illustrations. pp. 351. $1 75. (*Now Ready*, May, 1863.)

Of this well-known handbook we may say that it retains all its old simplicity and clearness of arrangement and description, whilst it has received from the able editor those finishing touches which the progress of chemistry has rendered necessary.—*London Med. Times and Gazette*, Nov. 29, 1862.

Nor is anything hurried over, anything shirked; open the book where you will, you find the same careful treatment of the subject manifested, and the best process for the attainment of the particular object in view lucidly detailed and explained. And this new edition is not merely a reprint of the last. With a laudable desire to keep the book up to the scientific mark of the present age, every improvement in analytical method has been introduced. In conclusion, we would only say that, familiar from long acquaintance with each page of the former issues of this little book, we gladly place beside them another presenting so many acceptable improvements and additions.—*Dublin Medical Press*, Jan. 7, 1863.

BY THE SAME AUTHOR.

INTRODUCTION TO PRACTICAL CHEMISTRY, INCLUDING ANALYSIS. Second American, from the second and revised London edition. With numerous illustrations. In one neat vol., royal 12mo., extra cloth. pp. 288. $1 25.

BEALE ON THE LAWS OF HEALTH IN RELATION TO MIND AND BODY. A Series of Letters from an old Practitioner to a Patient. In one volume, royal 12mo., extra cloth. pp. 296. 80 cents.

BUSHNAN'S PHYSIOLOGY OF ANIMAL AND VEGETABLE LIFE; a Popular Treatise on the Functions and Phenomena of Organic Life. In one handsome royal 12mo. volume, extra cloth, with over 100 illustrations. pp. 234. 80 cents.

BUCKLER ON THE ETIOLOGY, PATHOLOGY, AND TREATMENT OF FIBRO-BRONCHITIS AND RHEUMATIC PNEUMONIA. In one 8vo. volume, extra cloth. pp. 150. $1 25.

BLOOD AND URINE (MANUALS ON). BY JOHN WILLIAM GRIFFITH, G. OWEN REESE, AND ALFRED MARKWICK. One thick volume, royal 12mo., extra cloth, with plates. pp. 460. $1 25.

BRODIE'S CLINICAL LECTURES ON SURGERY. 1 vol. 8vo. cloth. 350 pp. $1 25.

BUMSTEAD (FREEMAN J.) M. D.,

Lecturer on Venereal Diseases at the College of Physicians and Surgeons, New York, &c.

THE PATHOLOGY AND TREATMENT OF VENEREAL DISEASES,

including the results of recent investigations upon the subject. With illustrations on wood. In one very handsome octavo volume, of nearly 700 pages, extra cloth; $3 75.

By far the most valuable contribution to this particular branch of practice that has seen the light within the last score of years. His clear and accurate descriptions of the various forms of venereal disease, and especially the methods of treatment he proposes, are worthy of the highest encomium. In these respects it is better adapted for the assistance of the every-day practitioner than any other with which we are acquainted. In variety of methods proposed, in minuteness of direction, guided by careful discrimination of varying forms and complications, we write down the book as unsurpassed. It is a work which should be in the possession of every practitioner.—*Chicago Med. Journal*. Nov. 1861.

The foregoing admirable volume comes to us, embracing the whole subject of syphilology, resolving many a doubt, correcting and confirming many an entertained opinion, and in our estimation the best, completest, fullest monograph on this subject in our language. As far as the author's labors themselves are concerned, we feel it a duty to say that he has not only exhausted his subject, but he has presented to us, without the slightest hyperbole, the best digested treatise on these diseases in our language He has carried its literature down to the present moment, and has achieved his task in a manner which cannot but redound to his credit.—*British American Journal*, Oct. 1861.

We believe this treatise will come to be regarded as high authority in this branch of medical practice, and we cordially commend it to the favorable notice of our brethren in the profession. For our own part, we candidly confess that we have received many new ideas from its perusal, as well as modified many views which we have long, and, as we now think erroneously entertained on the subject of syphilis. To sum up all in a few words, this book is one which no practising physician or medical student can very well afford to do without.—*American Med. Times*, Nov. 2, 1861.

The whole work presents a complete history of venereal diseases, comprising much interesting and valuable material that has been spread through medical journals within the last twenty years—the period of many experiments and investigations on the subject—the whole carefully digested by the aid of the author's extensive personal experience, and offered to the profession in an admirable form. Its completeness is secured by good plates, which are especially full in the anatomy of the genital organs. We have examined it with great satisfaction, and congratulate the medical profession in America on the nationality of a work that may fairly be called original.—*Berkshire Med. Journal*, Dec. 1861.

One thing, however, we are impelled to say, that we have met with no other book on syphilis, in the English language, which gave so full, clear, and impartial views of the important subjects on which it treats. We cannot, however, refrain from expressing our satisfaction with the full and perspicuous manner in which the subject has been presented, and the careful attention to minute details, so useful—not to say indispensable—in a practical treatise. In conclusion, if we may be pardoned the use of a phrase now become stereotyped, but which we here employ in all seriousness and sincerity, we do not hesitate to express the opinion that Dr. Bumstead's Treatise on Venereal Diseases is a "work without which no medical library will hereafter be considered complete."—*Boston Med. and Surg. Journal*, Sept. 5, 1861.

BARCLAY (A. W.), M. D.,

Assistant Physician to St. George's Hospital, &c.

A MANUAL OF MEDICAL DIAGNOSIS; being an Analysis of the Signs

and Symptoms of Disease. Second American from the second and revised London edition. In one neat octavo volume, extra cloth, of 451 pages. $2 25.

The demand for a second edition of this work shows that the vacancy which it attempts to supply has been recognized by the profession, and that the efforts of the author to meet the want have been successful. The revision which it has enjoyed will render it better adapted than before to afford assistance to the learner in the prosecution of his studies, and to the practitioner who requires a convenient and accessible manual for speedy reference in the exigencies of his daily duties. For this latter purpose its complete and extensive Index renders it especially valuable, offering facilities for immediately turning to any class of symptoms, or any variety of disease.

The task of composing such a work is neither an easy nor a light one; but Dr. Barclay has performed it in a manner which meets our most unqualified approbation. He is no mere theorist; he knows his work thoroughly, and in attempting to perform it, has not exceeded his powers.—*British Med. Journal*.

We venture to predict that the work will be deservedly popular, and soon become, like Watson's Practice, an indispensable necessity to the practitioner.—*N. A. Med. Journal*.

An inestimable work of reference for the young practitioner and student.—*Nashville Med. Journal*.

We hope the volume will have an extensive circulation, not among students of medicine only, but practitioners also. They will never regret a faithful study of its pages.—*Cincinnati Lancet*.

An important acquisition to medical literature. It is a work of high merit, both from the vast importance of the subject upon which it treats, and also from the real ability displayed in its elaboration. In conclusion, let us bespeak for this volume that attention of every student of our art which it so richly deserves—that place in every medical library which it can so well adorn.—*Peninsular Medical Journal*.

BARTLETT (ELISHA), M. D.

THE HISTORY, DIAGNOSIS, AND TREATMENT OF THE FEVERS

OF THE UNITED STATES. A new and revised edition. By ALONZO CLARK, M. D., Prof. of Pathology and Practical Medicine in the N. Y. College of Physicians and Surgeons, &c. In one octavo volume, of six hundred pages, extra cloth. Price $3 00.

It is a work of great practical value and interest, containing much that is new relative to the several diseases of which it treats, and, with the additions of the editor, is fully up to the times. The distinctive features of the different forms of fever are plainly and forcibly portrayed, and the lines of demarcation carefully and accurately drawn, and to the American practitioner is a more valuable and safe guide than any work on fever extant.—*Ohio Med. and Surg Journal*.

This excellent monograph on febrile disease, has stood deservedly high since its first publication. It will be seen that it has now reached its fourth edition under the supervision of Prof. A. Clark, a gentleman who, from the nature of his studies and pursuits, is well calculated to appreciate and discuss the many intricate and difficult questions in pathology. His annotations add much to the interest of the work, and have brought it well up to the condition of the science as it exists at the present day in regard to this class of diseases.—*Southern Med. and Surg. Journal*.

BRANDE (WM. T.) D. C. L., AND ALFRED S. TAYLOR, M. D., F. R. S.

Of her Majesty's Mint, &c. Professor of Chemistry and Medical Jurisprudence in Guy's Hospital.

CHEMISTRY. In one handsome 8vo. volume of 696 pages, extra cloth. $3 50.

(*Now Ready*, May, 1863)

"Having been engaged in teaching Chemistry in this Metropolis, the one for a period of forty, and the other for a period of thirty years, it has appeared to us that, in spite of the number of books already existing, there was room for an additional volume, which should be especially adapted for the use of students. In preparing such a volume for the press, we have endeavored to bear in mind, that the student in the present day has much to learn, and but a short time at his disposal for the acquisition of this learning."—AUTHORS' PREFACE.

In reprinting this volume, its passage through the press has been superintended by a competent chemist, who has sedulously endeavored to secure the accuracy so necessary in a work of this nature. No notes or additions have been introduced, but the publishers have been favored by the authors with some corrections and revisions of the first twenty-one chapters, which have been duly inserted.

In so progressive a science as Chemistry, the latest work always has the advantage of presenting the subject as modified by the results of the latest investigations and discoveries. That this advantage has been made the most of, and that the work possesses superior attractions arising from its clearness, simplicity of style, and lucid arrangement, are manifested by the unanimous testimony of the English medical press.

It needs no great sagacity to foretell that this book will be, literally, the Handbook in Chemistry of the student and practitioner. For clearness of language, accuracy of description, extent of information, and freedom from pedantry and mysticism of modern chemistry, no other text-book comes into competition with it. The result is a work which for fulness of matter, for lucidity of arrangement, for clearness of style, is as yet without a rival. And long will it be without a rival. For, although with the necessary advance of chemical knowledge addenda will be required, there will be little to take away. The fundamental excellences of the book will remain, preserving it for years to come, what it now is, the best guide to the study of Chemistry yet given to the world.—*London Lancet*, Dec. 20, 1862.

Most assuredly, time has not abated one whit of the fluency, the vigor, and the clearness with which they not only have composed the work before us, but have, so to say, cleared the ground for it, by hitting right and left at the affectation, mysticism, and obscurity which pervade some late chemical treatises. Thus conceived, and worked out in the most sturdy, common sense method, this book gives, in the clearest and most summary method possible, all the facts and doctrines of chemistry, with more especial reference to the wants of the medical student.—*London Medical Times and Gazette*, Nov. 29, 1862.

If we are not very much mistaken, this book will occupy a place which none has hitherto held among chemists; for, by avoiding the errors of previous authors, we have a work which, for its size, is certainly the most perfect of any in the English language. There are several points to be noted in this volume which separate it widely from any of its compeers—its wide application, not to the medical student only, nor to the student in chemistry merely, but to every branch of science, art, or commerce which is in any way connected with the domain of chemistry.—*London Med. Review*, Feb. 1863.

BARWELL (RICHARD,) F. R. C. S.,

Assistant Surgeon Charing Cross Hospital, &c.

A TREATISE ON DISEASES OF THE JOINTS. Illustrated with engravings on wood. In one very handsome octavo volume, of about 500 pages, extra cloth; $3 00.

At the outset we may state that the work is worthy of much praise, and bears evidence of much thoughtful and careful inquiry, and here and there of no slight originality. We have already carried this notice further than we intended to do, but not to the extent the work deserves. We can only add, that the perusal of it has afforded us great pleasure. The author has evidently worked very hard at his subject, and his investigations into the Physiology and Pathology of Joints have been carried on in a manner which entitles him to be listened to with attention and respect. We must not omit to mention the very admirable plates with which the volume is enriched. We seldom meet with such striking and faithful delineations of disease.—*London Med. Times and Gazette*, Feb. 9, 1861.

This volume will be welcomed, as the record of much honest research and careful investigation into the nature and treatment of a most important class of disorders. We cannot conclude this notice of a valuable and useful book without calling attention to the amount of *bonâ fide* work it contains. It is no slight matter for a volume to show laborious investigation, and at the same time original thought, on the part of its author, whom we may congratulate on the successful completion of his arduous task.—*London Lancet*, March 9, 1861.

CARPENTER (WILLIAM B.), M. D., F. R. S., &c.,

Examiner in Physiology and Comparative Anatomy in the University of London.

THE MICROSCOPE AND ITS REVELATIONS. With an Appendix containing the Applications of the Microscope to Clinical Medicine, &c. By F. G. SMITH, M. D. Illustrated by four hundred and thirty-four beautiful engravings on wood. In one large and very handsome octavo volume, of 724 pages, extra cloth, $4 50.

The great importance of the microscope as a means of diagnosis, and the number of microscopists who are also physicians, have induced the American publishers, with the author's approval, to add an Appendix, carefully prepared by Professor Smith, on the applications of the instrument to clinical medicine, together with an account of American Microscopes, their modifications and accessories. This portion of the work is illustrated with nearly one hundred wood-cuts, and, it is hoped, will adapt the volume more particularly to the use of the American student.

Those who are acquainted with Dr. Carpenter's previous writings on Animal and Vegetable Physiology, will fully understand how vast a store of knowledge he is able to bring to bear upon so comprehensive a subject as the revelations of the microscope; and even those who have no previous acquaintance with the construction or uses of this instrument, will find abundance of information conveyed in clear and simple language.—Med. Times and Gazette.

The additions by Prof. Smith give it a positive claim upon the profession, for which we doubt not he will receive their sincere thanks. Indeed, we know not where the student of medicine will find such a complete and satisfactory collection of microscopic facts bearing upon physiology and practical medicine as is contained in Prof. Smith's appendix; and this of itself, it seems to us, is fully worth the cost of the volume.—Louisville Medical Review.

CARPENTER (WILLIAM B.), M. D., F. R. S.,

Examiner in Physiology and Comparative Anatomy in the University of London.

PRINCIPLES OF HUMAN PHYSIOLOGY; with their chief applications to Psychology, Pathology, Therapeutics, Hygiene, and Forensic Medicine. A new American, from the last and revised London edition. With nearly three hundred illustrations. Edited, with additions, by FRANCIS GURNEY SMITH, M. D., Professor of the Institutes of Medicine in the Pennsylvania Medical College, &c. In one very large and beautiful octavo volume, of about nine hundred large pages, handsomely printed and strongly bound in leather, with raised bands. $4 75.

For upwards of thirteen years Dr. Carpenter's work has been considered by the profession generally, both in this country and England, as the most valuable compendium on the subject of physiology in our language. This distinction it owes to the high attainments and unwearied industry of its accomplished author. The present edition (which, like the last American one, was prepared by the author himself), is the result of such extensive revision, that it may almost be considered a new work. We need hardly say, in concluding this brief notice, that while the work is indispensable to every student of medicine in this country, it will amply repay the practitioner for its perusal by the interest and value of its contents.—*Boston Med. and Surg. Journal.*

This is a standard work—the text-book used by all medical students who read the English language. It has passed through several editions in order to keep pace with the rapidly growing science of Physiology. Nothing need be said in its praise, for its merits are universally known; we have nothing to say of its defects, for they only appear where the science of which it treats is incomplete.—*Western Lancet.*

The most complete exposition of physiology which any language can at present give.—*Brit. and For. Med.-Chirurg. Review.*

The greatest, the most reliable, and the best book on the subject which we know of in the English language.—*Stethoscope.*

To eulogize this great work would be superfluous. We should observe, however, that in this edition the author has remodelled a large portion of the former, and the editor has added much matter of interest, especially in the form of illustrations. We may confidently recommend it as the most complete work on Human Physiology in our language.—*Southern Med. and Surg. Journal.*

The most complete work on the science in our language.—*Am. Med. Journal.*

The most complete work now extant in our language.—*N. O. Med. Register.*

The best text-book in the language on this extensive subject.—*London Med. Times.*

A complete cyclopædia of this branch of science. —*N. Y. Med. Times.*

The profession of this country, and perhaps also of Europe, have anxiously and for some time awaited the announcement of this new edition of Carpenter's Human Physiology. His former editions have for many years been almost the only text-book on Physiology in all our medical schools, and its circulation among the profession has been unsurpassed by any work in any department of medical science.

It is quite unnecessary for us to speak of this work as its merits would justify. The mere announcement of its appearance will afford the highest pleasure to every student of Physiology, while its perusal will be of infinite service in advancing physiological science.—*Ohio Med. and Surg. Journ.*

BY THE SAME AUTHOR.

ELEMENTS (OR MANUAL) OF PHYSIOLOGY, INCLUDING PHYSIOLOGICAL ANATOMY. Second American, from a new and revised London edition. With one hundred and ninety illustrations. In one very handsome octavo volume, leather. pp. 566. $3 00.

In publishing the first edition of this work, its title was altered from that of the London volume, by the substitution of the word "Elements" for that of "Manual," and with the author's sanction the title of "Elements" is still retained as being more expressive of the scope of the treatise.

BY THE SAME AUTHOR.

PRINCIPLES OF COMPARATIVE PHYSIOLOGY. New American, from the Fourth and Revised London edition. In one large and handsome octavo volume, with over three hundred beautiful illustrations. pp. 752. Extra cloth, $5 25.

This book should not only be read but thoroughly studied by every member of the profession. None are too wise or old, to be benefited thereby. But especially to the younger class would we cordially commend it as best fitted of any work in the English language to qualify them for the reception and comprehension of those truths which are daily being developed in physiology.—*Medical Counsellor.*

Without pretending to it, it is an encyclopedia of the subject, accurate and complete in all respects—a truthful reflection of the advanced state at which the science has now arrived.—*Dublin Quarterly Journal of Medical Science.*

A truly magnificent work—in itself a perfect physiological study.—*Ranking's Abstract.*

This work stands without its fellow. It is one few men in Europe could have undertaken; it is one no man, we believe, could have brought to so successful an issue as Dr. Carpenter. It required for its production a physiologist at once deeply read in the labors of others, capable of taking a general, critical, and unprejudiced view of those labors, and of combining the varied, heterogeneous materials at his disposal, so as to form an harmonious whole. We feel that this abstract can give the reader a very imperfect idea of the fulness of this work, and no idea of its unity, of the admirable manner in which material has been brought, from the most various sources, to conduce to its completeness, of the lucidity of the reasoning it contains, or of the clearness of language in which the whole is clothed. Not the profession only, but the scientific world at large, must feel deeply indebted to Dr Carpenter for this great work. It must, indeed, add largely even to his high reputation.—*Medical Times.*

BY THE SAME AUTHOR. (*Preparing.*)

PRINCIPLES OF GENERAL PHYSIOLOGY, INCLUDING ORGANIC CHEMISTRY AND HISTOLOGY. With a General Sketch of the Vegetable and Animal Kingdom. In one large and very handsome octavo volume, with several hundred illustrations.

BY THE SAME AUTHOR.

A PRIZE ESSAY ON THE USE OF ALCOHOLIC LIQUORS IN HEALTH AND DISEASE. New edition, with a Preface by D. F. CONDIE, M. D., and explanations of scientific words. In one neat 12mo. volume, extra cloth. pp. 178. 50 cents.

CONDIE (D. F.), M. D., &c.

A PRACTICAL TREATISE ON THE DISEASES OF CHILDREN. Fifth edition, revised and augmented. In one large volume, 8vo., extra cloth, of over 750 pages. $3 25.

In presenting a new and revised edition of this favorite work, the publishers have only to state that the author has endeavored to render it in every respect "a complete and faithful exposition of the pathology and therapeutics of the maladies incident to the earlier stages of existence—a full and exact account of the diseases of infancy and childhood." To accomplish this he has subjected the whole work to a careful and thorough revision, rewriting a considerable portion, and adding several new chapters. In this manner it is hoped that any deficiencies which may have previously existed have been supplied, that the recent labors of practitioners and observers have been thoroughly incorporated, and that in every point the work will be found to maintain the high reputation it has enjoyed as a complete and thoroughly practical book of reference in infantile affections.

A few notices of previous editions are subjoined.

Dr. Condie's scholarship, acumen, industry, and practical sense are manifested in this, as in all his numerous contributions to science.—*Dr. Holmes's Report to the American Medical Association.*

Taken as a whole, in our judgment, Dr. Condie's Treatise is the one from the perusal of which the practitioner in this country will rise with the greatest satisfaction.—*Western Journal of Medicine and Surgery.*

One of the best works upon the Diseases of Children in the English language.—*Western Lancet.*

We feel assured from actual experience that no physician's library can be complete without a copy of this work.—*N. Y. Journal of Medicine.*

A veritable pædiatric encyclopædia, and an honor to American medical literature.—*Ohio Medical and Surgical Journal.*

We feel persuaded that the American medical profession will soon regard it not only as a very good, but as the VERY BEST "Practical Treatise on the Diseases of Children."—*American Medical Journal.*

In the department of infantile therapeutics, the work of Dr. Condie is considered one of the best which has been published in the English language. —*The Stethoscope.*

We pronounced the first edition to be the best work on the diseases of children in the English language, and, notwithstanding all that has been published, we still regard it in that light.—*Medical Examiner.*

The value of works by native authors on the diseases which the physician is called upon to combat, will be appreciated by all; and the work of Dr. Condie has gained for itself the character of a safe guide for students, and a useful work for consultation by those engaged in practice.—*N. Y. Med. Times.*

This is the fourth edition of this deservedly popular treatise. During the interval since the last edition, it has been subjected to a thorough revision by the author; and all new observations in the pathology and therapeutics of children have been included in the present volume. As we said before, we do not know of a better book on diseases of children, and to a large part of its recommendations we yield an unhesitating concurrence.—*Buffalo Med. Journal.*

Perhaps the most full and complete work now before the profession of the United States; indeed, we may say in the English language. It is vastly superior to most of its predecessors.—*Transylvania Med. Journal.*

CHRISTISON (ROBERT), M. D., V. P. R. S. E., &c.

A DISPENSATORY; or, Commentary on the Pharmacopœias of Great Britain and the United States; comprising the Natural History, Description, Chemistry, Pharmacy, Actions, Uses, and Doses of the Articles of the Materia Medica. Second edition, revised and improved, with a Supplement containing the most important New Remedies. With copious Additions, and two hundred and thirteen large wood-engravings. By R. EGLESFELD GRIFFITH, M. D. In one very large and handsome octavo volume, extra cloth, of over 1000 pages. $3 50.

COOPER (BRANSBY B.), F. R. S.

LECTURES ON THE PRINCIPLES AND PRACTICE OF SURGERY.

In one very large octavo volume, extra cloth, of 750 pages. $3 00.

COOPER ON DISLOCATIONS AND FRACTURES OF THE JOINTS.—Edited by BRANSBY B. COOPER, F. R. S., &c. With additional Observations by Prof. J. C. WARREN. A new American edition. In one handsome octavo volume, extra cloth, of about 500 pages, with numerous illustrations on wood. $3 25.

COOPER ON THE ANATOMY AND DISEASES OF THE BREAST, with twenty-five Miscellaneous and Surgical Papers. One large volume, imperial 8vo., extra cloth, with 252 figures, on 36 plates. $2 50.

COOPER ON THE STRUCTURE AND DISEASES OF THE TESTIS, AND ON THE THYMUS GLAND. One vol. imperial 8vo., extra cloth, with 177 figures on 29 plates. $2 00.

COPLAND ON THE CAUSES, NATURE, AND TREATMENT OF PALSY AND APOPLEXY. In one volume, royal 12mo., extra cloth. pp. [illegible]. 80 cents.

CLYMER ON FEVERS; THEIR DIAGNOSIS, PATHOLOGY, AND TREATMENT. In one octavo volume, leather, of 600 pages. $1 50.

COLOMBAT DE L'ISERE ON THE DISEASES OF FEMALES, and on the special Hygiene of their Sex. Translated, with many Notes and Additions, by C. D. MEIGS, M. D. Second edition, revised and improved. In one large volume, octavo, leather, with numerous wood-cuts. pp. 7[illegible]. $3 50.

CARSON (JOSEPH), M. D.,

Professor of Materia Medica and Pharmacy in the University of Pennsylvania.

SYNOPSIS OF THE COURSE OF LECTURES ON MATERIA MEDICA AND PHARMACY, delivered in the University of Pennsylvania.

CURLING (T. B.), F. R. S.,

Surgeon to the London Hospital, President of the Hunterian Society, &c.

A PRACTICAL TREATISE ON DISEASES OF THE TESTIS, SPERMATIC CORD, AND SCROTUM. Second American, from the second and enlarged English edition. In one handsome octavo vo ume, extra cloth, with numerous illustrations. pp. [illegible]. [illegible]

CHURCHILL (FLEETWOOD), M. D., M. R. I. A.

ON THE THEORY AND PRACTICE OF MIDWIFERY.

A new American from the fourth revised and enlarged London edition. With Notes and Additions, by D. Francis Condie, M. D., author of a "Practical Treatise on the Diseases of Children," &c. With 194 illustrations. In one very handsome octavo volume, leather, of nearly 700 large pages. $3 75.

This work has been so long an established favorite, both as a text-book for the learner and as a reliable aid in consultation for the practitioner, that in presenting a new edition it is only necessary to call attention to the very extended improvements which it has received. Having had the benefit of two revisions by the author since the last American reprint, it has been materially enlarged, and Dr. Churchill's well-known conscientious industry is a guarantee that every portion has been thoroughly brought up with the latest results of European investigation in all departments of the science and art of obstetrics. The recent date of the last Dublin edition has not left much of novelty for the American editor to introduce, but he has endeavored to insert whatever has since appeared, together with such matters as his experience has shown him would be desirable for the American student, including a large number of illustrations. With the sanction of the author he has added in the form of an appendix, some chapters from a little "Manual for Midwives and Nurses," recently issued by Dr. Churchill, believing that the details there presented can hardly fail to prove of advantage to the junior practitioner. The result of all these additions is that the work now contains fully one-half more matter than the last American edition, with nearly one-half more illustrations, so that notwithstanding the use of a smaller type, the volume contains almost two hundred pages more than before.

No effort has been spared to secure an improvement in the mechanical execution of the work equal to that which the text has received, and the volume is confidently presented as one of the handsomest that has thus far been laid before the American profession; while the very low price at which it is offered should secure for it a place in every lecture-room and on every office table.

A better book in which to learn these important points we have not met than Dr. Churchill's. Every page of it is full of instruction; the opinion of all writers of authority is given on questions of difficulty, as well as the directions and advice of the learned author himself, to which he adds the result of statistical inquiry, putting statistics in their proper place and giving them their due weight, and no more. We have never read a book more free from professional jealousy than Dr. Churchill's. It appears to be written with the true design of a book on medicine, viz: to give all that is known on the subject of which he treats, both theoretically and practically, and to advance such opinions of his own as he believes will benefit medical science, and insure the safety of the patient. We have said enough to convey to the profession that this book of Dr. Churchill's is admirably suited for a book of reference for the practitioner, as well as a text-book for the student, and we hope it may be extensively purchased amongst our readers. To them we most strongly recommend it.—*Dublin Medical Press*

To bestow praise on a book that has received such marked approbation would be superfluous. We need only say, therefore, that if the first edition was thought worthy of a favorable reception by the medical public, we can confidently affirm that this will be found much more so. The lecturer, the practitioner, and the student, may all have recourse to its pages, and derive from their perusal much interest and instruction in everything relating to theoretical and practical midwifery.—*Dublin Quarterly Journal of Medical Science*.

A work of very great merit, and such as we can confidently recommend to the study of every obstetric practitioner.—*London Medical Gazette*.

Few treatises will be found better adapted as a text-book for the student, or as a manual for the frequent consultation of the young practitioner.—*American Medical Journal*.

Were we reduced to the necessity of having but *one* work on midwifery, and *permitted to choose*, we would unhesitatingly take Churchill.—*Western Med. and Surg. Journal*.

It is impossible to conceive a more useful and elegant manual than Dr. Churchill's Practice of Midwifery.—*Provincial Medical Journal*.

Certainly, in our opinion, the very best work on the subject which exists.—*N. Y. Annalist*.

No work holds a higher position, or is more deserving of being placed in the hands of the tyro, the advanced student, or the practitioner.—*Medical Examiner*.

Previous editions have been received with marked favor, and they deserved it; but this, reprinted from a very late Dublin edition, carefully revised and brought up by the author to the present time, does present an unusually accurate and able exposition of every important particular embraced in the department of midwifery. * * The clearness, directness, and precision of its teachings, together with the great amount of statistical research which its text exhibits, have served to place it already in the foremost rank of works in this department of remedial science.—*N. O. Med. and Surg. Journal*.

In our opinion, it forms one of the best if not the very best text-book and epitome of obstetric science which we at present possess in the English language.—*Monthly Journal of Medical Science*.

The clearness and precision of style in which it is written, and the great amount of statistical research which it contains, have served to place it in the first rank of works in this department of medical science. —*N. Y. Journal of Medicine*.

This is certainly the most perfect system extant. It is the best adapted for the purposes of a text-book, and that which he whose necessities confine him to one book, should select in preference to all others.—*Southern Medical and Surgical Journal*.

BY THE SAME AUTHOR. (*Lately Published.*)

ON THE DISEASES OF INFANTS AND CHILDREN.

Second American Edition, revised and enlarged by the author. Edited, with Notes, by W. V. Keating, M. D. In one large and handsome volume, extra cloth, of over 700 pages. $3 25.

In preparing this work a second time for the American profession, the author has spared no labor in giving it a very thorough revision, introducing several new chapters, and rewriting others, while every portion of the volume has been subjected to a severe scrutiny. The efforts of the American editor have been directed to supplying such information relative to matters peculiar to this country as might have escaped the attention of the author, and the whole may, therefore, be safely pronounced one of the most complete works on the subject accessible to the American Profession. By an alteration in the size of the page, these very extensive additions have been accommodated without unduly increasing the size of the work.

BY THE SAME AUTHOR.

ESSAYS ON THE PUERPERAL FEVER, AND OTHER DISEASES PECULIAR TO WOMEN.

Selected from the writings of British Authors previous to the close of *the Eighteenth Century*. In one neat octavo volume, extra cloth, of about 450 pages. $2 50.

CHURCHILL (FLEETWOOD), M. D., M. R. I. A., &c.

ON THE DISEASES OF WOMEN; including those of Pregnancy and Childbed.

A new American edition, revised by the Author. With Notes and Additions, by D. Francis Condie, M. D., author of "A Practical Treatise on the Diseases of Children." With numerous illustrations. In one large and handsome octavo volume, extra cloth, of 768 pages. $3 00.

This edition of Dr. Churchill's very popular treatise may almost be termed a new work, so thoroughly has he revised it in every portion. It will be found greatly enlarged, and completely brought up to the most recent condition of the subject, while the very handsome series of illustrations introduced, representing such pathological conditions as can be accurately portrayed, present a novel feature, and afford valuable assistance to the young practitioner. Such additions as appeared desirable for the American student have been made by the editor, Dr. Condie, while a marked improvement in the mechanical execution keeps pace with the advance in all other respects which the volume has undergone, while the price has been kept at the former very moderate rate.

It comprises, unquestionably, one of the most exact and comprehensive expositions of the present state of medical knowledge in respect to the diseases of women that has yet been published.—*Am. Journ. Med. Sciences.*

This work is the most reliable which we possess on this subject; and is deservedly popular with the profession.—*Charleston Med. Journal*, July, 1857.

We know of no author who deserves that approbation, on "the diseases of females," to the same extent that Dr. Churchill does. His, indeed, is the only thorough treatise we know of on the subject; and it may be commended to practitioners and students as a masterpiece in its particular department.—*The Western Journal of Medicine and Surgery.*

As a comprehensive manual for students, or a work of reference for practitioners, it surpasses any other that has ever issued on the same subject from the British press.—*Dublin Quart. Journal.*

DICKSON (S. H.), M. D.,

Professor of Practice of Medicine in the Jefferson Medical College, Philadelphia.

ELEMENTS OF MEDICINE; a Compendious View of Pathology and Therapeutics, or the History and Treatment of Diseases.

Second edition, revised. In one large and handsome octavo volume, of 750 pages, extra cloth. $3 75.

The steady demand which has so soon exhausted the first edition of this work, sufficiently shows that the author was not mistaken in supposing that a volume of this character was needed—an elementary manual of practice, which should present the leading principles of medicine with the practical results, in a condensed and perspicuous manner. Disencumbered of unnecessary detail and fruitless speculations, it embodies what is most requisite for the student to learn, and at the same time what the active practitioner wants when obliged, in the daily calls of his profession, to refresh his memory on special points. The clear and attractive style of the author renders the whole easy of comprehension, while his long experience gives to his teachings an authority everywhere acknowledged. Few physicians, indeed, have had wider opportunities for observation and experience, and few, perhaps, have used them to better purpose. As the result of a long life devoted to study and practice, the present edition, revised and brought up to the date of publication, will doubtless maintain the reputation already acquired as a condensed and convenient American text-book on the Practice of Medicine.

DRUITT (ROBERT), M. R. C. S., &c.

THE PRINCIPLES AND PRACTICE OF MODERN SURGERY.

A new and revised American from the eighth enlarged and improved London edition. Illustrated with four hundred and thirty-two wood-engravings. In one very handsomely printed octavo volume, leather, of nearly 700 large pages. $3 75.

A work which like Druitt's Surgery has for so many years maintained the position of a leading favorite with all classes of the profession, needs no special recommendation to attract attention to a revised edition. It is only necessary to state that the author has spared no pains to keep the work up to its well earned reputation of presenting in a small and convenient compass the latest condition of every department of surgery, considered both as a science and as an art; and that the services of a competent American editor have been employed to introduce whatever novelties may have escaped the author's attention, or may prove of service to the American practitioner. As several editions have appeared in London since the issue of the last American reprint, the volume has had the benefit of repeated revisions by the author, resulting in a very thorough alteration and improvement. The extent of these additions may be estimated from the fact that it now contains about one-third more matter than the previous American edition, and that notwithstanding the adoption of a smaller type, the pages have been increased by about one hundred, while nearly two hundred and fifty wood-cuts have been added to the former list of illustrations.

A marked improvement will also be perceived in the mechanical and artistical execution of the work, which, printed in the best style, on new type, and fine paper, leaves little to be desired as regards external finish; while at the very low price affixed it will be found one of the cheapest volumes accessible to the profession.

This popular volume, now a most comprehensive work on surgery, has undergone many corrections, improvements, and additions, and the principles and the practice of the art have been brought down to the latest record and observation. Of the operations in surgery it is impossible to speak too highly. The descriptions are so clear and concise, and the illustrations so accurate and numerous, that the student can have no difficulty, with instrument in hand, and book by his side, over the dead body, in obtaining a proper knowledge and sufficient tact in this much neglected department of medical education.—*British and Foreign Medico-Chirurg. Review*, Jan. 1860.

In the present edition the author has entirely rewritten many of the chapters, and has incorporated the various improvements and additions in modern surgery. On carefully going over it, we find that nothing of real practical importance has been omitted; it presents a faithful epitome of everything relating to surgery up to the present hour. It is deservedly a popular manual, both with the student and practitioner.—*London Lancet*, Nov. 19, 1859.

In closing this brief notice, we recommend as cordially as ever this most useful and comprehensive hand-book. It must prove a vast assistance, not only to the student of surgery, but also to the busy practitioner who may not have the leisure to devote himself to the study of more lengthy volumes.—*London Med. Times and Gazette*, Oct. 22, 1859.

In a word, this eighth edition of Dr. Druitt's Manual of Surgery is all that the surgical student or practitioner could desire.—Dublin Quarterly Journal of Med. Sciences, Nov. 1859.

DALTON, JR. (J. C.), M. D.

Professor of Physiology in the College of Physicians, New York.

A TREATISE ON HUMAN PHYSIOLOGY, designed for the use of Students and Practitioners of Medicine. Second edition, revised and enlarged, with two hundred and seventy-one illustrations on wood. In one very beautiful octavo volume, of 700 pages, extra cloth, $4 00; leather, raised bands, $4 50.

The general favor which has so soon exhausted an edition of this work has afforded the author an opportunity in its revision of supplying the deficiencies which existed in the former volume. This has caused the insertion of two new chapters—one on the Special Senses, the other on Imbibition, Exhalation, and the Functions of the Lymphatic System—besides numerous additions of smaller amount scattered through the work, and a general revision designed to bring it thoroughly up to the present condition of the science with regard to all points which may be considered as definitely settled. A number of new illustrations has been introduced, and the work, it is hoped, in its improved form, may continue to command the confidence of those for whose use it is intended

It will be seen, therefore, that Dr. Dalton's best efforts have been directed towards perfecting his work. The additions are marked by the same features which characterize the remainder of the volume, and render it by far the most desirable text-book on physiology to place in the hands of the student which, so far as we are aware, exists in the English language, or perhaps in any other. We therefore have no hesitation in recommending Dr. Dalton's book for the classes for which it is intended, satisfied as we are that it is better adapted to their use than any other work of the kind to which they have access.—*American Journal of the Med. Sciences*, April, 1861.

It is, therefore, no disparagement to the many books upon physiology, most excellent in their day, to say that Dalton's is the only one that gives us the science as it was known to the best philosophers throughout the world, at the beginning of the current year. It states in comprehensive but concise diction, the facts established by experiment, or other method of demonstration, and details, in an understandable manner, how it is done, but abstains from the discussion of unsettled or theoretical points. Herein it is unique; and these characteristics render it a text-book without a rival, for those who desire to study physiological science as it is known to its most successful cultivators. And it is physiology thus presented that lies at the foundation of correct pathological knowledge; and this in turn is the basis of rational therapeutics; so that pathology, in fact, becomes of prime importance in the proper discharge of our every-day practical duties. —*Cincinnati Lancet*, May, 1861.

Dr. Dalton needs no word of praise from us. He is universally recognized as among the first, if not the very first, of American physiologists now living. The first edition of his admirable work appeared but two years since, and the advance of science, his own original views and experiments, together with a desire to supply what he considered some deficiencies in the first edition, have already made the present one a necessity, and it will no doubt be even more eagerly sought for than the first. That it is not merely a reprint, will be seen from the author's statement of the following principal additions and alterations which he has made. The present, like the first edition, is printed in the highest style of the printer's art, and the illustrations are truly admirable for their clearness in expressing exactly what their author intended.—*Boston Medical and Surgical Journal*, March 28, 1861.

It is unnecessary to give a detail of the additions; suffice it to say, that they are numerous and important, and such as will render the work still more valuable and acceptable to the profession as a learned and original treatise on this all-important branch of medicine. All that was said in commendation of the getting up of the first edition, and the superior style of the illustrations, apply with equal force to this. No better work on physiology can be placed in the hand of the student.—*St. Louis Medical and Surgical Journal*, May, 1861.

These additions, while testifying to the learning and industry of the author, render the book exceedingly useful, as the most complete exposé of a science, of which Dr. Dalton is doubtless the ablest representative on this side of the Atlantic.—*New Orleans Med. Times*, May, 1861.

A second edition of this deservedly popular work having been called for in the short space of two years, the author has supplied deficiencies, which existed in the former volume, and has thus more completely fulfilled his design of presenting to the profession a reliable and precise text-book, and one which we consider the best outline on the subject of which it treats, in any language.—*N. American Medico-Chirurg. Review*, May, 1861.

DUNGLISON, FORBES, TWEEDIE, AND CONOLLY.

THE CYCLOPÆDIA OF PRACTICAL MEDICINE: comprising Treatises on the Nature and Treatment of Diseases, Materia Medica, and Therapeutics, Diseases of Women and Children, Medical Jurisprudence, &c. &c. In four large super-royal octavo volumes, of 3254 double-columned pages, strongly and handsomely bound, with raised bands. $12 00.

*** This work contains no less than four hundred and eighteen distinct treatises, contributed by sixty-eight distinguished physicians, rendering it a complete library of reference for the country practitioner.

The most complete work on Practical Medicine extant; or, at least, in our language.—*Buffalo Medical and Surgical Journal.*

For reference, it is above all price to every practitioner.—*Western Lancet.*

One of the most valuable medical publications of the day—as a work of reference it is invaluable.—*Western Journal of Medicine and Surgery.*

It has been to us, both as learner and teacher, a work for ready and frequent reference, one in which modern English medicine is exhibited in the most advantageous light.—*Medical Examiner.*

The editors are practitioners of established reputation, and the list of contributors embraces many of the most eminent professors and teachers of London, Edinburgh, Dublin, and Glasgow. It is, indeed, the great merit of this work that the principal articles have been furnished by practitioners who have not only devoted especial attention to the diseases about which they have written, but have also enjoyed opportunities for an extensive practical acquaintance with them and whose reputation carries the assurance of their competency justly to appreciate the opinions of others, while it stamps their own doctrines with high and just authority.—*American Medical Journal.*

DEWEES'S COMPREHENSIVE SYSTEM OF MIDWIFERY. Illustrated by occasional cases and many engravings. Twelfth edition, with the author's last improvements and corrections In *one octavo volume, extra cloth, of* 600 pages. $3 20.

DEWEES'S TREATISE ON THE PHYSICAL **AND MEDICAL TREATMENT OF CHILDREN.** The last edition. In one volume, octavo, extra cloth, 548 pages. $2 80

DEWEES'S TREATISE ON THE DISEASES OF FEMALES. Tenth edition. In one volume, octavo extra cloth, 532 pages, with plates. $3 00.

DUNGLISON (ROBLEY), M. D.,

Professor of Institutes of Medicine in the Jefferson Medical College, Philadelphia.

NEW AND ENLARGED EDITION.

MEDICAL LEXICON; a Dictionary of Medical Science, containing a concise Explanation of the various Subjects and Terms of Anatomy, Physiology, Pathology, Hygiene, Therapeutics, Pharmacology, Pharmacy, Surgery, Obstetrics, Medical Jurisprudence, Dentistry, &c. Notices of Climate and of Mineral Waters; Formulæ for Officinal, Empirical, and Dietetic Preparations, &c. With French and other Synonymes. Revised and very greatly enlarged. In one very large and handsome octavo volume, of 992 double-columned pages, in small type; strongly bound in leather. Price $4 00.

Especial care has been devoted in the preparation of this edition to render it in every respect worthy a continuance of the very remarkable favor which it has hitherto enjoyed. The rapid sale of FIFTEEN large editions, and the constantly increasing demand, show that it is regarded by the profession as the standard authority. Stimulated by this fact, the author has endeavored in the present revision to introduce whatever might be necessary "to make it a satisfactory and desirable—if not indispensable—lexicon, in which the student may search without disappointment for every term that has been legitimated in the nomenclature of the science." To accomplish this, large additions have been found requisite, and the extent of the author's labors may be estimated from the fact that about SIX THOUSAND subjects and terms have been introduced throughout, rendering the whole number of definitions about SIXTY THOUSAND, to accommodate which, the number of pages has been increased by nearly a hundred, notwithstanding an enlargement in the size of the page. The medical press, both in this country and in England, has pronounced the work indispensable to all medical students and practitioners, and the present improved edition will not lose that enviable reputation.

The publishers have endeavored to render the mechanical execution worthy of a volume of such universal use in daily reference. The greatest care has been exercised to obtain the typographical accuracy so necessary in a work of the kind. By the small but exceedingly clear type employed, an immense amount of matter is condensed in its thousand ample pages, while the binding will be found strong and durable. With all these improvements and enlargements, the price has been kept at the former very moderate rate, placing it within the reach of all.

This work, the appearance of the fifteenth edition of which, it has become our duty and pleasure to announce, is perhaps the most stupendous monument of labor and erudition in medical literature. One would hardly suppose after constant use of the preceding editions, where we have never failed to find a sufficiently full explanation of every medical term, that in this edition "*about six thousand subjects and terms have been added*," with a careful revision and correction of the entire work. It is only necessary to announce the advent of this edition to make it occupy the place of the preceding one on the table of every medical man, as it is without doubt the best and most comprehensive work of the kind which has ever appeared.—*Buffalo Med. Journ.*, Jan. 1858.

The work is a monument of patient research, skilful judgment, and vast physical labor, that will perpetuate the name of the author more effectually than any possible device of stone or metal. Dr. Dunglison deserves the thanks not only of the American profession, but of the whole medical world.—*North Am. Medico-Chir. Review*, Jan. 1858.

A Medical Dictionary better adapted for the wants of the profession than any other with which we are acquainted, and of a character which places it far above comparison and competition.—*Am. Journ. Med. Sciences*, Jan. 1858.

We need only say, that the addition of 6,000 new terms, with their accompanying definitions, may be said to constitute a new work, by itself. We have examined the Dictionary attentively, and are most happy to pronounce it unrivalled of its kind. The erudition displayed, and the extraordinary industry which must have been demanded, in its preparation and perfection, redound to the lasting credit of its author, and have furnished us with a volume *indispensable* at the present day, to all who would find themselves *au niveau* with the highest standards of medical information.—*Boston Medical and Surgical Journal*, Dec. 31, 1857.

Good lexicons and encyclopedic works generally, are the most labor-saving contrivances which literary men enjoy; and the labor which is required to produce them in the perfect manner of this example is something appalling to contemplate. The author tells us in his preface that he has added about six thousand terms and subjects to this edition, which, before, was considered universally as the best work of the kind in any language.—*Silliman's Journal*, March, 1858.

He has razed his gigantic structure to the foundations, and remodelled and reconstructed the entire pile. No less than *six thousand* additional subjects and terms are illustrated and analyzed in this new edition, swelling the grand aggregate to beyond sixty thousand! Thus is placed before the profession a complete and thorough exponent of medical terminology, without rival or possibility of rivalry. —*Nashville Journ. of Med. and Surg.*, Jan. 1858.

It is universally acknowledged, we believe, that this work is incomparably the best and most complete Medical Lexicon in the English language. The amount of labor which the distinguished author has bestowed upon it is truly wonderful, and the learning and research displayed in its preparation are equally remarkable. Comment and commendation are unnecessary, as no one at the present day thinks of purchasing any other Medical Dictionary than this.—*St. Louis Med. and Surg. Journ.*, Jan. 1858.

It is the foundation stone of a good medical library, and should always be included in the first list of books purchased by the medical student.—*Am. Med. Monthly*, Jan. 1858.

A very perfect work of the kind, undoubtedly the most perfect in the English language.—*Med. and Surg. Reporter*, Jan. 1858.

It is now emphatically *the* Medical Dictionary of the English language, and for it there is no substitute.—*N. H. Med. Journ.*, Jan. 1858.

It is scarcely necessary to remark that any medical library wanting a copy of Dunglison's Lexicon must be imperfect.—*Cin. Lancet*, Jan. 1858.

We have ever considered it the best authority published, and the present edition we may safely say has no equal in the world.—*Peninsular Med. Journal*, Jan. 1858.

The most complete authority on the subject to be found in any language.—*Va. Med. Journal*, Feb. '58.

BY THE SAME AUTHOR.

THE PRACTICE OF MEDICINE. A Treatise on Special Pathology and Therapeutics. Third Edition. In two large octavo volumes, leather, of 1,500 pages. $6 25.

DUNGLISON (ROBLEY), M. D.,

Professor of Institutes of Medicine in the Jefferson Medical College, Philadelphia.

HUMAN PHYSIOLOGY. Eighth edition. Thoroughly revised and extensively modified and enlarged, with five hundred and thirty-two illustrations. In two large and handsomely printed octavo volumes, extra cloth, of about 1500 pages. $7 00.

In revising this work for its eighth appearance, the author has spared no labor to render it worthy a continuance of the very great favor which has been extended to it by the profession. The whole contents have been rearranged, and to a great extent remodelled; the investigations which of late years have been so numerous and so important, have been carefully examined and incorporated, and the work in every respect has been brought up to a level with the present state of the subject. The object of the author has been to render it a concise but comprehensive treatise, containing the whole body of physiological science, to which the student and man of science can at all times refer with the certainty of finding whatever they are in search of, fully presented in all its aspects; and on no former edition has the author bestowed more labor to secure this result.

We believe that it can truly be said, no more complete repertory of facts upon the subject treated, can anywhere be found. The author has, moreover, that enviable tact at description and that facility and ease of expression which render him peculiarly acceptable to the casual, or the studious reader. This faculty, so requisite in setting forth many graver and less attractive subjects, lends additional charms to one always fascinating.—*Boston Med. and Surg. Journal.*

The most complete and satisfactory system of Physiology in the English language.—*Amer. Med. Journal.*

The best work of the kind in the English language.—*Silliman's Journal.*

The present edition the author has made a perfect mirror of the science as it is at the present hour. As a work upon physiology proper, the science of the functions performed by the body, the student will find it all he wishes.—*Nashville Journ. of Med.*

That he has succeeded, most admirably succeeded in his purpose, is apparent from the appearance of an eighth edition. It is now the great encyclopædia on the subject, and worthy of a place in every physician's library.—*Western Lancet.*

BY THE SAME AUTHOR. (*A new edition.*)

GENERAL THERAPEUTICS AND MATERIA MEDICA; adapted for a Medical Text-book. With Indexes of Remedies and of Diseases and their Remedies. Sixth Edition, revised and improved. With one hundred and ninety-three illustrations. In two large and handsomely printed octavo vols., extra cloth, of about 1100 pages. $6 00.

In announcing a new edition of Dr. Dunglison's General Therapeutics and Materia Medica, we have no words of commendation to bestow upon a work whose merits have been heretofore so often and so justly extolled. It must not be supposed, however, that the present is a mere reprint of the previous edition; the character of the author for laborious research, judicious analysis, and clearness of expression, is fully sustained by the numerous additions he has made to the work, and the careful revision to which he has subjected the whole.—*N. A. Medico-Chir. Review*, Jan. 1858.

The work will, we have little doubt, be bought and read by the majority of medical students; its size, arrangement, and reliability recommend it to all; no one, we venture to predict, will study it without profit, and there are few to whom it will not be in some measure useful as a work of reference. The young practitioner, more especially, will find the copious indexes appended to this edition of great assistance in the selection and preparation of suitable formulæ.—*Charleston Med. Journ. and Review*, Jan. 1858.

BY THE SAME AUTHOR. (*A new Edition.*)

NEW REMEDIES, WITH FORMULÆ FOR THEIR PREPARATION AND ADMINISTRATION. Seventh edition, with extensive Additions. In one very large octavo volume, extra cloth, of 770 pages. $3 75.

One of the most useful of the author's works.—*Southern Medical and Surgical Journal.*

This elaborate and useful volume should be found in every medical library, for as a book of reference, for physicians, it is unsurpassed by any other work in existence, and the double index for diseases and for remedies, will be found greatly to enhance its value.—*New York Med. Gazette.*

The great learning of the author, and his remarkable industry in pushing his researches into every source whence information is derivable, have enabled him to throw together an extensive mass of facts and statements, accompanied by full reference to authorities; which last feature renders the work practically valuable to investigators who desire to examine the original papers.—*The American Journal of Pharmacy.*

ELLIS (BENJAMIN), M. D.

THE MEDICAL FORMULARY: being a Collection of Prescriptions, derived from the writings and practice of many of the most eminent physicians of America and Europe. Together with the usual Dietetic Preparations and Antidotes for Poisons. To which is added an Appendix, on the Endermic use of Medicines, and on the use of Ether and Chloroform. The whole accompanied with a few brief Pharmaceutic and Medical Observations. Eleventh edition, revised and much extended by Robert P. Thomas, M. D., Professor of Materia Medica in the Philadelphia College of Pharmacy. In one volume, 8vo. (*Preparing for early publication.*)

This work has been allowed to remain for some time out of print, awaiting the appearance of the new U. S. Pharmacopœia. Immediately on the publication of the latter it will be issued, and those who have been desirous of procuring it may rely upon obtaining an edition thoroughly brought up with all that has appeared of value since the last edition was issued, and fully worthy to maintain the reputation of this old and favorite work.

ERICHSEN (JOHN),

Professor of Surgery in University College, London, &c.

THE SCIENCE AND ART OF SURGERY; BEING A TREATISE ON SURGICAL INJURIES, DISEASES, AND OPERATIONS.

New and improved American, from the second enlarged and carefully revised London edition. Illustrated with over four hundred engravings on wood. In one large and handsome octavo volume, of one thousand closely printed pages, leather, raised bands. $5 00.

The very distinguished favor with which this work has been received on both sides of the Atlantic has stimulated the author to render it even more worthy of the position which it has so rapidly attained as a standard authority. Every portion has been carefully revised, numerous additions have been made, and the most watchful care has been exercised to render it a complete exponent of the most advanced condition of surgical science. In this manner the work has been enlarged by about a hundred pages, while the series of engravings has been increased by more than a hundred, rendering it one of the most thoroughly illustrated volumes before the profession. The additions of the author having rendered unnecessary most of the notes of the former American editor, but little has been added in this country; some few notes and occasional illustrations have, however, been introduced to elucidate American modes of practice.

It is, in our humble judgment decidedly the best book of the kind in the English language. Strange that just such books are not oftener produced by public teachers of surgery in this country and Great Britain. Indeed, it is a matter of great astonishment, but no less true than astonishing, that of the many works on surgery republished in this country within the last fifteen or twenty years as text-books for medical students, this is the only one that even approximates to the fulfilment of the peculiar wants of young men just entering upon the study of this branch of the profession.—*Western Jour. of Med. and Surgery.*

Its value is greatly enhanced by a very copious well-arranged index. We regard this as one of the most valuable contributions to modern surgery. To one entering his novitiate of practice, we regard it the most serviceable guide which he can consult. He will find a fulness of detail leading him through every step of the operation, and not deserting him until the final issue of the case is decided.—*Sethoscope.*

Embracing, as will be perceived, the whole surgical domain, and each division of itself almost complete and perfect, each chapter full and explicit, each subject faithfully exhibited, we can only express our estimate of it in the aggregate. We consider it an excellent contribution to surgery, as probably the best single volume now extant on the subject, and with great pleasure we add it to our text-books.—*Nashville Journal of Medicine and Surgery.*

Prof. Erichsen's work, for its size, has not been surpassed; his nine hundred and eight pages, profusely illustrated, are rich in physiological, pathological, and operative suggestions, doctrines, details, and processes; and will prove a reliable resource for information, both to physician and surgeon, in the hour of peril.—*N. O. Med. and Surg. Journal.*

FLINT (AUSTIN), M. D.,

Professor of the Theory and Practice of Medicine in the University of Louisville, &c.

PHYSICAL EXPLORATION AND DIAGNOSIS OF DISEASES AFFECTING THE RESPIRATORY ORGANS.

In one large and handsome octavo volume, extra cloth, 636 pages. $3 00.

We regard it, in point both of arrangement and of the marked ability of its treatment of the subjects, as destined to take the first rank in works of this class. So far as our information extends, it has at present no equal. To the practitioner, as well as the student, it will be invaluable in clearing up the diagnosis of doubtful cases, and in shedding light upon difficult phenomena.—*Buffalo Med. Journal.*

A work of original observation of the highest merit. We recommend the treatise to every one who wishes to become a correct auscultator. Based to a very large extent upon cases numerically examined, it carries the evidence of careful study and discrimination upon every page. It does credit to the author and, through him, to the profession in this country It is, what we cannot call every book upon auscultation, a readable book.—*Am. Jour. Med. Sciences*

This volume belongs to a class of works which confer honor upon their authors and enrich the domain of practical medicine. A cursory examination even will satisfy the scientific physician that Dr. Flint in this treatise has added to medical literature a work based upon original observation, and possessing no ordinary merit.—*N. Y. Journal of Med.*

This is an admirable book, and because of its extraordinary clearness and entire mastery of the subjects discussed, has made itself indispensable to those who are ambitious of a thorough knowledge of physical exploration.—*Nashville Journ of Med.*

The arrangement of the subjects discussed is easy, natural, such as to present the facts in the most forcible light. Where the author has avoided being tediously minute or diffuse, he has nevertheless fully amplified the more important points. In this respect, indeed, his labors will take precedence, and be the means of inviting to this useful department a more general attention.—*O. Med and Surg. Journ.*

We hope these few extracts taken from Dr. Flint's work may convey some idea of its character and importance. We would, however, advise every physician to at once place it in his library, feeling assured that it may be consulted with great benefit both by young and old.—*Louisville Review.*

BY THE SAME AUTHOR. (*Now Ready.*)

A PRACTICAL TREATISE ON THE DIAGNOSIS, PATHOLOGY, AND TREATMENT OF DISEASES OF THE HEART.

In one neat octavo volume, of about 500 pages, extra cloth. $2 75.

We do not know that Dr. Flint has written anything which is not first rate; but this, his latest contribution to medical literature, in our opinion, surpasses all the others. The work is most comprehensive in its scope, and most sound in the views it enunciates. The descriptions are clear and methodical; the statements are substantiated by facts, and are made with such simplicity and sincerity, that without them they would carry conviction. The style is admirably clear, direct, and free from dryness With Dr. Walshe's excellent treatise before us, we have no hesitation in saying that Dr. Flint's book is the best work on the heart in the English language. —*Boston Med. and Surg. Journal.*

We have thus endeavored to present our readers with a fair analysis of this remarkable work. Preferring to employ the very words of the distinguished author, wherever it was possible, we have essayed to condense into the briefest space a general view of his observations and suggestions, and to direct the attention of our brethren to the abounding stores of valuable matter here collected and arranged for their use and instruction. No medical library will hereafter be considered complete without this volume; and we trust it will promptly find its way into the hands of every American student and physician.—*N. Am. Med. Chir. Review.*

With more than pleasure do we hail the advent of this work, for it fills a wide gap on the list of text-books for our schools, and is, for the practitioner, the most valuable practical work of its kind.—*N. O. Med. News.*

FOWNES (GEORGE), PH. D., &c.

A MANUAL OF ELEMENTARY CHEMISTRY; Theoretical and Practical. With one hundred and ninety-seven illustrations. Edited by Robert Bridges, M. D. In one large royal 12mo volume, of 600 pages, extra cloth, $1 65.

The death of the author having placed the editorial care of this work in the practised hands of Drs. Bence Jones and A. W. Hoffman, everything has been done in its revision which experience could suggest to keep it on a level with the rapid advance of chemical science. The additions requisite to this purpose have necessitated an enlargement of the page, notwithstanding which the work has been increased by about fifty pages. At the same time every care has been used to maintain its distinctive character as a condensed manual for the student, divested of all unnecessary detail or mere theoretical speculation. The additions have, of course, been mainly in the department of Organic Chemistry, which has made such rapid progress within the last few years, but yet equal attention has been bestowed on the other branches of the subject—Chemical Physics and Inorganic Chemistry—to present all investigations and discoveries of importance, and to keep up the reputation of the volume as a complete manual of the whole science, admirably adapted for the learner. By the use of a small but exceedingly clear type the matter of a large octavo is compressed within the convenient and portable limits of a moderate sized duodecimo, and at the very low price affixed, it is offered as one of the cheapest volumes before the profession.

Dr. Fownes' excellent work has been universally recognized everywhere in his own and this country, as the best elementary treatise on chemistry in the English tongue, and is very generally adopted, we believe, as the standard text-book in all our colleges, both literary and scientific.—*Charleston Med. Journ. and Review.*

A standard manual, which has long enjoyed the reputation of embodying much knowledge in a small space. The author has achieved the difficult task of condensation with masterly tact. His book is concise without being dry, and brief without being too dogmatical or general.—*Virginia Med. and Surgical Journal.*

The work of Dr. Fownes has long been before the public, and its merits have been fully appreciated as the best text-book on chemistry now in existence. We do not, of course, place it in a rank superior to the works of Brande, Graham, Turner, Gregory, or Gmelin, but we say that, as a work for students, it is preferable to any of them.—*London Journal of Medicine.*

A work well adapted to the wants of the student. It is an excellent exposition of the chief doctrines and facts of modern chemistry. The size of the work, and still more the condensed yet perspicuous style in which it is written, absolve it from the charges very properly urged against most manuals termed popular.—*Edinburgh Journal of Medical Science.*

FISKE FUND PRIZE ESSAYS.—THE EFFECTS OF CLIMATE ON TUBERCULOUS DISEASE. By Edwin Lee, M. R. C. S., London, and THE INFLUENCE OF PREGNANCY ON THE DEVELOPMENT OF TUBERCLES By Edward Warren, M. D., of Edenton, N. C. Together in one neat 8vo volume, extra cloth. $1 00.

FRICK ON RENAL AFFECTIONS; their Diagnosis and Pathology. With illustrations. One volume, royal 12mo., extra cloth. 75 cents.

FERGUSSON (WILLIAM), F. R. S.,

Professor of Surgery in King's College, London, &c.

A SYSTEM OF PRACTICAL SURGERY. Fourth American, from the third and enlarged London edition. In one large and beautifully printed octavo volume, of about 700 pages, with 393 handsome illustrations, leather. $3 00.

GRAHAM (THOMAS), F. R. S.

THE ELEMENTS OF INORGANIC CHEMISTRY, including the Applications of the Science in the Arts. New and much enlarged edition, by Henry Watts and Robert Bridges, M. D. Complete in one large and handsome octavo volume, of over 800 very large pages, with two hundred and thirty-two wood-cuts, extra cloth. $4 50.

⁂ Part II., completing the work from p. 431 to end, with Index, Title Matter, &c., may be had separate, cloth backs and paper sides. Price $2 50.

From Prof. E. N. Horsford, Harvard College.

It has, in its earlier and less perfect editions, been familiar to me, and the excellence of its plan and the clearness and completeness of its discussions, have long been my admiration.

No reader of English works on this science can afford to be without this edition of Prof. Graham's Elements.—*Silliman's Journal*, March, 1858.

From Prof. Wolcott Gibbs, N. Y. Free Academy.

The work is an admirable one in all respects, and its republication here cannot fail to exert a positive influence upon the progress of science in this country.

GRIFFITH (ROBERT E.), M. D., &c.

A UNIVERSAL FORMULARY, containing the methods of Preparing and Administering Officinal and other Medicines. The whole adapted to Physicians and Pharmaceutists. Second Edition, thoroughly revised, with numerous additions, by Robert P. Thomas, M. D., Professor of Materia Medica in the Philadelphia College of Pharmacy. In one large and handsome octavo volume, extra cloth, of 650 pages, double columns. $3 25.

It was a work requiring much perseverance, and when published was looked upon as by far the best work of its kind that had issued from the American press. Prof Thomas has certainly "improved," as well as added to this Formulary, and has rendered it additionally deserving of the confidence of pharmaceutists and physicians.—*Am. Journal of Pharmacy.*

We are happy to announce a new and improved edition of this, one of the most valuable and useful works that have emanated from an American pen. It would do credit to any country, and will be found of daily usefulness to practitioners of medicine; it is better adapted to their purposes than the dispensatories.—*Southern Med. and Surg. Journal.*

It is one of the most useful books a country practitioner can possibly have.—Medical Chronicle.

This is a work of six hundred and fifty-one pages, embracing all on the subject of preparing and administering medicines that can be desired by the physician and pharmaceutist.—*Western Lancet.*

The amount of useful, every-day matter, for a practicing physician, is really immense.—*Boston Med. and Surg. Journal.*

This edition has been greatly improved by the revision and ample additions of Dr Thomas, and is now, we believe, one of the most complete works of its kind in any language. The additions amount to about seventy pages, and no effort has been spared to include in them all the recent improvements. A work of this kind appears to us indispensable to the physician, and there is none we can more cordially recommend.—N. Y. Journal of Medicine.

GROSS (SAMUEL D.), M. D.,

Professor of Surgery in the Jefferson Medical College of Philadelphia, &c.

Enlarged Edition.

A SYSTEM OF SURGERY: Pathological, Diagnostic, Therapeutic, and Operative.

Illustrated by TWELVE HUNDRED AND TWENTY-SEVEN ENGRAVINGS. Second edition, much enlarged and carefully revised. In two large and beautifully printed octavo volumes, of about twenty-two hundred pages; strongly bound in leather. Price $12.

The exhaustion in little more than two years of a large edition of so elaborate and comprehensive a work as this is the best evidence that the author was not mistaken in his estimate of the want which existed of a complete American System of Surgery, presenting the science in all its necessary details and in all its branches. That he has succeeded in the attempt to supply this want is shown not only by the rapid sale of the work, but also by the very favorable manner in which it has been received by the organs of the profession in this country and in Europe, and by the fact that a translation is now preparing in Holland—a mark of appreciation not often bestowed on any scientific work so extended in size

The author has not been insensible to the kindness thus bestowed upon his labors, and in revising the work for a new edition he has spared no pains to render it worthy of the favor with which it has been received. Every portion has been subjected to close examination and revision; any deficiencies apparent have been supplied, and the results of recent progress in the science and art of surgery have been everywhere introduced; while the series of illustrations has been enlarged by the addition of nearly three hundred wood-cuts, rendering it one of the most thoroughly illustrated works ever laid before the profession. To accommodate these very extensive additions, the work has been printed upon a smaller type, so that notwithstanding the very large increase in the matter and value of the book, its size is more convenient and less cumbrous than before. Every care has been taken in the printing to render the typographical execution unexceptionable, and it is confidently presented as a work in every way worthy of a place in even the most limited library of the practitioner or student.

Has Dr. Gross satisfactorily fulfilled this object? A careful perusal of his volumes enables us to give an answer in the affirmative. Not only has he given to the reader an elaborate and well-written account of his own vast experience, but he has not failed to embody in his pages the opinions and practice of surgeons in this and other countries of Europe. The result has been a work of such completeness, that it has no superior in the systematic treatises on surgery which have emanated from English or Continental authors. It has been justly objected that these have been far from complete in many essential particulars, many of them having been deficient in some of the most important points which should characterize such works Some of them have been elaborate—too elaborate—with respect to certain diseases, while they have merely glanced at, or given an unsatisfactory account of, others equally important to the surgeon. Dr. Gross has avoided this error, and has produced the most complete work that has yet issued from the press on the science and practice of surgery. It is not, strictly speaking, a Dictionary of Surgery, but it gives to the reader all the information that he may require for his treatment of surgical diseases. Having said so much, it might appear superfluous to add another word; but it is only due to Dr. Gross to state that he has embraced the opportunity of transferring to his pages a vast number of engravings from English and other authors, illustrative of the pathology and treatment of surgical diseases. To these are added several hundred original wood-cuts. The work altogether commends itself to the attention of British surgeons, from whom it cannot fail to meet with extensive patronage.—*London Lancet*, Sept. 1, 1860.

Of Dr. Gross's treatise on Surgery we can say no more than that it is the most elaborate and complete work on this branch of the healing art which has ever been published in any country. A systematic work, it admits of no analytical review; but, did our space permit, we should gladly give some extracts from it, to enable our readers to judge of the classical style of the author, and the exhausting way in which each subject is treated.—*Dub Quarterly Journal of Med. Science.*

The work is so superior to its predecessors in matter and extent, as well as in illustrations and style of publication, that we can honestly recommend it as the best work of the kind to be taken home by the young practitioner.—*Am. Med. Journ.*

With pleasure we record the completion of this long-anticipated work. The reputation which the author has for many years sustained, both as a surgeon and as a writer, had prepared us to expect a treatise of great excellence and originality; but we confess we were by no means prepared for the work which is before us—the most complete treatise upon surgery ever published, either in this or any other country, and we might, perhaps, safely say, the most original. There is no subject belonging properly to surgery which has not received from the author a due share of attention. Dr. Gross has supplied a want in surgical literature which has long been felt by practitioners; he has furnished us with a complete practical treatise upon surgery in all its departments As Americans, we are proud of the achievement; as surgeons, we are most sincerely thankful to him for his extraordinary labors in our behalf.—*N. Y. Review and Buffalo Med Journal.*

BY THE SAME AUTHOR.

ELEMENTS OF PATHOLOGICAL ANATOMY. Third edition, thoroughly

revised and greatly improved. In one large and very handsome octavo volume, with about three hundred and fifty beautiful illustrations, of which a large number are from original drawings, extra cloth. $4 75.

The very rapid advances in the Science of Pathological Anatomy during the last few years have rendered essential a thorough modification of this work, with a view of making it a correct exponent of the present state of the subject. The very careful manner in which this task has been executed, and the amount of alteration which it has undergone, have enabled the author to say that "with the many changes and improvements now introduced, the work may be regarded almost as a new treatise," while the efforts of the author have been seconded as regards the mechanical execution of the volume, rendering it one of the handsomest productions of the American press.

We most sincerely congratulate the author on the successful manner in which he has accomplished his proposed object. His book is most admirably calculated to fill up a blank which has long been felt to exist in this department of medical literature, and as such must become very widely circulated amongst all classes of the profession.—*Dublin Quarterly Journ. of Med.* Science, Nov. 1857.

We have been favorably impressed with the general manner in which Dr. Gross has executed his task of affording a comprehensive digest of the present state of the literature of Pathological Anatomy, and have much pleasure in recommending his work to our readers, as we believe one well deserving of diligent perusal and careful study.—*Montreal Med. Chron.*, Sept. 1857.

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON FOREIGN BODIES IN THE AIR-PASSAGES.

In one handsome octavo volume, extra cloth, with illustrations. pp. 468. $2 75.

GROSS (SAMUEL D.), M. D.,

Professor of Surgery in the Jefferson Medical College of Philadelphia, &c.

A PRACTICAL TREATISE ON THE DISEASES, INJURIES, AND MALFORMATIONS OF THE URINARY BLADDER, THE PROSTATE GLAND, AND THE URETHRA. Second Edition, revised and much enlarged, with one hundred and eighty-four illustrations. In one large and very handsome octavo volume, of over nine hundred pages, extra cloth, $4 75.

Philosophical in its design, methodical in its arrangement, ample and sound in its practical details, it may in truth be said to leave scarcely anything to be desired on so important a subject.—*Boston Med. and Surg Journal.*

Whoever will peruse the vast amount of valuable practical information it contains, will, we think, agree with us, that there is no work in the English language which can make any just pretensions to be its equal.—*N. Y. Journal of Medicine.*

A volume replete with truths and principles of the utmost value in the investigation of these diseases.—*American Medical Journal.*

GRAY (HENRY), F. R. S.,

Lecturer on Anatomy at St. George's Hospital, London, &c.

ANATOMY, DESCRIPTIVE AND SURGICAL. The Drawings by H. V. CARTER, M. D., late Demonstrator on Anatomy at St. George's Hospital; the Dissections jointly by the AUTHOR and Dr. CARTER. Second American, from the second revised and improved London edition. In one magnificent imperial octavo volume, of over 800 pages, with 388 large and elaborate engravings on wood. Price in extra cloth, $6 25; leather, raised bands, $7 00.

The speedy exhaustion of a large edition of this work is sufficient evidence that its plan and execution have been found to present superior practical advantages in facilitating the study of Anatomy. In presenting it to the profession a second time, the author has availed himself of the opportunity to supply any deficiencies which experience in its use had shown to exist, and to correct any errors of detail, to which the first edition of a scientific work on so extensive and complicated a science is liable. These improvements have resulted in some increase in the size of the volume, while twenty-six new wood-cuts have been added to the beautiful series of illustrations which form so distinctive a feature of the work. The American edition has been passed through the press under the supervision of a competent professional man, who has taken every care to render it in all respects accurate, and it is now presented, without any increase of price, as fitted to maintain and extend the popularity which it has everywhere acquired.

With little trouble, the busy practitioner whose knowledge of anatomy may have become obscured by want of practice, may now resuscitate his former anatomical lore, and be ready for any emergency. It is to this class of individuals, and not to the student alone, that this work will ultimately tend to be of most incalculable advantage, and we feel satisfied that the library of the medical man will soon be considered incomplete in which a copy of this work does not exist.—*Madras Quarterly Journal of Med. Science*, July, 1861.

This edition is much improved and enlarged, and contains several new illustrations by Dr. Westmacott. The volume is a complete companion to the dissecting-room, and saves the necessity of the student possessing a variety of "Manuals."—*The London Lancet*, Feb. 9, 1861.

The work before us is one entitled to the highest praise, and we accordingly welcome it as a valuable addition to medical literature. Intermediate in fulness of detail between the treatises of Sharpey and of Wilson, its characteristic merit lies in the number and excellence of the engravings it contains. Most of these are original, of much larger than ordinary size, and admirably executed. The various parts are also lettered after the plan adopted in Holden's Osteology. It would be difficult to over-estimate the advantages offered by this mode of pictorial illustration. Bones, ligaments, muscles, bloodvessels, and nerves are each in turn figured, and marked with their appropriate names; thus enabling the student to comprehend, at a glance, what would otherwise often be ignored, or at any rate, acquired only by prolonged and irksome application. In conclusion, we heartily commend the work of Mr. Gray to the attention of the medical profession, feeling certain that it should be regarded as one of the most valuable contributions ever made to educational literature.—*N. Y. Monthly Review.* Dec. 1859.

In this view, we regard the work of Mr. Gray as far better adapted to the wants of the profession, and especially of the student, than any treatise on anatomy yet published in this country. It is destined, we believe, to supersede all others, both as a manual of dissections, and a standard of reference to the student of general or relative anatomy.—*N. Y. Journal of Medicine*, Nov. 1859.

For this truly admirable work the profession is indebted to the distinguished author of "Gray on the Spleen." The vacancy it fills has been long felt to exist in this country. Mr. Gray writes throughout with both branches of his subject in view. His description of each particular part is followed by a notice of its relations to the parts with which it is connected, and this, too, sufficiently ample for all the purposes of the operative surgeon. After describing the bones and muscles, he gives a concise statement of the fractures to which the bones of the extremities are most liable, together with the amount and direction of the displacement to which the fragments are subjected by muscular action. The section on arteries is remarkably full and accurate. Not only is the surgical anatomy given to every important vessel, with directions for its ligation, but at the end of the description of each arterial trunk we have a useful summary of the irregularities which may occur in its origin, course, and termination.—*N. A. Med. Chir. Review*, Mar. 1859.

Mr. Gray's book, in excellency of arrangement and completeness of execution, exceeds any work on anatomy hitherto published in the English language, affording a complete view of the structure of the human body, with especial reference to practical surgery. Thus the volume constitutes a perfect book of reference for the practitioner, demanding a place in even the most limited library of the physician or surgeon, and a work of necessity for the student to fix in his mind what he has learned by the dissecting knife from the book of nature.—*The Dublin Quarterly Journal of Med. Sciences*, Nov. 1858.

In our judgment, the mode of illustration adopted in the present volume cannot but present many advantages to the student of anatomy. To the zealous disciple of Vesalius, earnestly desirous of real improvement, the book will certainly be of immense value; but, at the same time, we must also confess that to those simply desirous of "cramming" it will be an undoubted godsend. The peculiar value of Mr. Gray's mode of illustration is nowhere more markedly evident than in the chapter on osteology, and especially in those portions which treat of the bones of the head and of their development. The study of these parts is thus made one of comparative ease, if not of positive pleasure; and those bugbears of the student, the temporal and sphenoid bones, are shorn of half their terrors. It is, in our estimation, an admirable and complete text-book for the student, and a useful work of reference for the practitioner; its pictorial character forming a novel element, to which we have already sufficiently alluded.—Am. Journ. Med. Sci., July, 1859.

GIBSON'S INSTITUTES AND PRACTICE OF SURGERY. Eighth edition, improved and altered. With thirty-four plates. In two handsome octavo volumes, containing about 1,000 pages, leather, raised bands. $6 50.

GARDNER'S MEDICAL CHEMISTRY, for the use of Students and the Profession. In one royal 12mo. vol., cloth, pp. 396, with wood-cuts. $1.

GLUGE'S ATLAS OF PATHOLOGICAL HISTOLOGY. Translated, with Notes and Additions. by JOSEPH LEIDY, M. D. In one volume, very large imperial quarto, extra cloth, with 320 copper-plate figures, plain and colored, $5 00.

HUGHES' INTRODUCTION TO THE PRACTICE OF AUSCULTATION AND OTHER MODES OF PHYSICAL DIAGNOSIS. IN DISEASES OF THE LUNGS AND HEART. Second edition 1 vol. royal 12mo., ex. cloth, pp. 304. $1 00.

HAMILTON (FRANK H.), M. D.,

Professor of Surgery in the Long Island College Hospital.

A PRACTICAL TREATISE ON FRACTURES AND DISLOCATIONS.

Second edition, revised and improved. In one large and handsome octavo volume, of over 750 pages, with nearly 300 illustrations, extra cloth, $4 75. (*Just Ready*, May, 1863.)

The early demand for a new edition of this work shows that it has been successful in securing the confidence of the profession as a standard authority for consultation and reference on its important and difficult subject. In again passing it through the press, the author has taken the opportunity to revise it carefully, and introduce whatever improvements have been suggested by further experience and observation An additional chapter on Gun-shot Fractures will be found to adapt it still more fully to the exigencies of the time.

Among the many good workers at surgery of whom America may now boast not the least is Frank Hastings Hamilton; and the volume before us is (we say it with a pang of wounded patriotism) the best and handiest book on the subject in the English language. It is in vain to attempt a review of it; nearly as vain to seek for any sins, either of commission or omission. We have seen no work on practical surgery which we would sooner recommend to our brother surgeons, especially those of "the services," or those whose practice lies in districts where a man has necessarily to rely on his own unaided resources. The practitioner will find in it directions for nearly every possible accident, easily found and comprehended; and much pleasant reading for him to muse over in the after consideration of his cases.—*Edinburgh Med. Journ* Feb. 1861.

This is a valuable contribution to the surgery of most important affections, and is the more welcome, inasmuch as at the present time we do not possess a single complete treatise on Fractures and Dislocations in the English language. It has remained for our American brother to produce a complete treatise upon the subject, and bring together in a convenient form those alterations and improvements that have been made from time to time in the treatment of these affections. One great and valuable feature in the work before us is the fact that it comprises all the improvements introduced into the practice of both English and American surgery, and though far from omitting mention of our continental neighbors, the author by no means encourages the notion—but too prevalent in some quarters—that nothing is good unless imported from France or Germany. The latter half of the work is devoted to the consideration of the various dislocations and their appropriate treatment. and its merit is fully equal to that of the preceding portion.—*The London Lancet*, May 5, 1860.

It is emphatically *the* book upon the subjects of which it treats, and we cannot doubt that it will continue so to be for an indefinite period of time. When we say, however, that we believe it will at once take its place as the best book for consultation by the practitioner; and that it will form the most complete, available, and reliable guide in emergencies of every nature connected with its subjects; and also that the student of surgery may make it his textbook with entire confidence, and with pleasure also, from its agreeable and easy style—we think our own opinion may be gathered as to its value.—*Boston Medical and Surgical Journal*, March 1, 1860.

The work is concise, judicious, and accurate, and adapted to the wants of the student, practitioner, and investigator, honorable to the author and to the profession.—*Chicago Med. Journal*, March, 1860.

We regard this work as an honor not only to its author, but to the profession of our country. Were we to review it thoroughly, we could not convey to the mind of the reader more forcibly our honest opinion expressed in the few words—we think it the best book of its kind extant. Every man interested in surgery will soon have this work on his desk. He who does not, will be the loser.—*New Orleans Medical News*, March, 1860.

Dr. Hamilton is fortunate in having succeeded in filling the void, so long felt, with what cannot fail to be at once accepted as a model monograph in some respects, and a work of classical authority. We sincerely congratulate the profession of the United States on the appearance of such a publication from one of their number. We have reason to be proud of it as an original work, both in a literary and scientific point of view. and to esteem it as a valuable guide in a most difficult and important branch of study and practice. On every account. therefore, we hope that it may soon be widely known abroad as an evidence of genuine progress on this side of the Atlantic, and further, that it may be still more widely known at home as an authoritative teacher from which every one may profitably learn, and as affording an example of honest, well-directed, and untiring industry in authorship which every surgeon may emulate.—*Am. Med. Journal*, April, 1860.

HOBLYN (RICHARD D.), M. D.

A DICTIONARY OF THE TERMS USED IN MEDICINE AND THE COLLATERAL SCIENCES.

A new American edition. Revised, with numerous Additions, by ISAAC HAYS, M. D., editor of the "American Journal of the Medical Sciences." In one large royal 12mo. volume, leather, of over 500 double columned pages. $1 50.

To both practitioner and student, we recommend this dictionary as being convenient in size, accurate in definition, and sufficiently full and complete for ordinary consultation.—*Charleston Med. Journ*.

We know of no dictionary better arranged and adapted. It is not encumbered with the obsolete terms of a bygone age, but it contains all that are now in use; embracing every department of medical science down to the very latest date —*Western Lancet*.

Hoblyn's Dictionary has long been a favorite with us. It is the best book of definitions we have, and ought always to be upon the student's table.—*Southern Med. and Surg. Journal*.

HOLLAND'S MEDICAL NOTES AND REFLECTIONS. From the third London edition. In one handsome octavo volume, extra cloth. $3.

HORNER'S SPECIAL ANATOMY AND HISTOLOGY. Eighth edition. Extensively revised and modified. In two large octavo volumes, extra cloth, of more than 1000 pages, with over 300 illustrations. $6 00.

HODGE (HUGH L.), M. D.,

Professor of Midwifery and the Diseases of Women and Children in the University of Pennsylvania, &c.

ON DISEASES PECULIAR TO WOMEN, including Displacements of the Uterus. With original illustrations. In one beautifully printed octavo volume, of nearly 500 pages, extra cloth. $3 25.

We will say at once that the work fulfils its object capitally well; and we will moreover venture the assertion that it will inaugurate an improved practice throughout this whole country. The secrets of the author's success are so clearly revealed that the attentive student cannot fail to insure a goodly portion of similar success in his own practice. It is a credit to *all* medical literature; and we add, that the physician who does not place it in his library, and who does not faithfully con its pages, will lose a vast deal of knowledge that would be most useful to himself and beneficial to his patients. *It is a practical work of the highest order of merit;* and it will take rank as such immediately.—*Maryland and Virginia Medical Journal*, Feb. 1861.

This contribution towards the elucidation of the pathology and treatment of some of the diseases peculiar to women, cannot fail to meet with a favorable reception from the medical profession. The character of the particular maladies of which the work before us treats; their frequency, variety, and obscurity; the amount of malaise and even of actual suffering by which they are invariably attended; their obstinacy, the difficulty with which they are overcome, and their disposition again and again to recur—these, taken in connection with the entire competency of the author to render a correct account of their nature, their causes, and their appropriate management—his ample experience, his matured judgment, and his perfect conscientiousness—invest this publication with an interest and value to which few of the medical treatises of a recent date can lay a stronger, if, perchance, an equal claim.—*Am. Journ. Med. Sciences*, Jan. 1861.

Indeed, although no part of the volume is not eminently deserving of perusal and study, we think that the nine chapters devoted to this subject, are especially so, and we know of no more valuable monograph upon the symptoms, prognosis, and management of these annoying maladies than is constituted by this part of the work. We cannot but regard it as one of the most original and most practical works of the day; one which every accoucheur and physician should most carefully read; for we are persuaded that he will arise from its perusal with new ideas, which will induct him into a more rational practice in regard to many a suffering female, who may have placed her health in his hands.—*British American Journal*, Feb. 1861.

Of the many excellences of the work we will not speak at length. We advise all who would acquire a knowledge of the proper management of the maladies of which it treats, to study it with care. The second part is of itself a most valuable contribution to the practice of our art.—*Am. Med. Monthly and New York Review*, Feb. 1861.

The illustrations, which are all original, are drawn to a uniform scale of one-half the natural size.

HABERSHON (S. O.), M. D.,

Assistant Physician to and Lecturer on Materia Medica and Therapeutics at Guy's Hospital, &c.

PATHOLOGICAL AND PRACTICAL OBSERVATIONS ON DISEASES OF THE ALIMENTARY CANAL, ŒSOPHAGUS, STOMACH, CÆCUM, AND INTESTINES. With illustrations on wood. In one handsome octavo volume of 312 pages, extra cloth $1 75.

JONES (T. WHARTON), F. R. S.,

Professor of Ophthalmic Medicine and Surgery in University College, London, &c.

THE PRINCIPLES AND PRACTICE OF OPHTHALMIC MEDICINE AND SURGERY. With one hundred and ten illustrations. Second American from the second and revised London edition, with additions by Edward Hartshorne, M. D., Surgeon to Wills' Hospital, &c. In one large, handsome royal 12mo. volume, extra cloth, of 500 pages. $1 50.

JONES (C. HANDFIELD), F. R. S., & EDWARD H. SIEVEKING, M.D.,

Assistant Physicians and Lecturers in St. Mary's Hospital, London.

A MANUAL OF PATHOLOGICAL ANATOMY. First American Edition, Revised. With three hundred and ninety-seven handsome wood engravings. In one large and beautiful octavo volume of nearly 750 pages, extra cloth. $3 75.

As a concise text-book, containing, in a condensed form, a complete outline of what is known in the domain of Pathological Anatomy, it is perhaps the best work in the English language. Its great merit consists in its completeness and brevity, and in this respect it supplies a great desideratum in our literature. Heretofore the student of pathology was obliged to glean from a great number of monographs, and the field was so extensive that but few cultivated it with any degree of success. As a simple work of reference, therefore, it is of great value to the student of pathological anatomy, and should be in every physician's library.—*Western Lancet.*

KIRKES (WILLIAM SENHOUSE), M. D.,

Demonstrator of Morbid Anatomy at St. Bartholomew's Hospital, &c.

A MANUAL OF PHYSIOLOGY. A new American, from the third and improved London edition. With two hundred illustrations. In one large and handsome royal 12mo. volume, extra cloth. pp. 586. $2 00.

This is a new and very much improved edition of Dr. Kirkes' well-known Handbook of Physiology. It combines conciseness with completeness, and is, therefore, admirably adapted for consultation by the busy practitioner.—*Dublin Quarterly Journal.*

One of the very best handbooks of Physiology we possess—presenting just such an outline of the science as the student requires during his attendance upon a course of lectures, or for reference whilst *preparing for examination.*—*Am. Medical Journal.*

Its excellence is in its compactness, its clearness, and its carefully cited authorities. It is the most convenient of text-books. These gentlemen, Messrs. Kirkes and Paget, have the gift of telling us what we want to know, without thinking it necessary to tell us all they know.—*Boston Med. and Surg. Journal.*

For the student beginning this study, and the practitioner who has but leisure to refresh his memory, this book is invaluable, as it contains all that it is important to know.—Charleston Med. Journal.

KNAPP'S TECHNOLOGY; or, Chemistry applied to the Arts and to Manufactures. Edited by Dr. RONALDS, Dr. RICHARDSON, and Prof. W. R. JOHNSON. In two handsome 8vo. vols., extra cloth, with about 500 wood-engravings. $6 00.

LAYCOCK'S LECTURES ON THE PRINCIPLES AND METHODS OF MEDICAL OBSERVATION AND RESEARCH. For the Use of Advanced Students and Junior Practitioners. In one royal 12mo. volume, extra cloth. Price $1.

LALLEMAND AND WILSON.

A PRACTICAL TREATISE ON THE CAUSES, SYMPTOMS, AND TREATMENT OF SPERMATORRHŒA. By M. LALLEMAND. Translated and edited by HENRY J McDOUGALL. Third American edition. To which is added ——— ON DISEASES OF THE VESICULÆ SEMINALES; AND THEIR ASSOCIATED ORGANS. With special reference to the Morbid Secretions of the Prostatic and Urethral Mucous Membrane. By MARRIS WILSON, M. D. In one neat octavo volume, of about 400 pp., extra cloth. $2 00.

LA ROCHE (R.), M. D., &c.

YELLOW FEVER, considered in its Historical, Pathological, Etiological, and Therapeutical Relations. Including a Sketch of the Disease as it has occurred in Philadelphia from 1699 to 1854, with an examination of the connections between it and the fevers known under the same name in other parts of temperate as well as in tropical regions. In two large and handsome octavo volumes of nearly 1500 pages, extra cloth. $7 00.

From Professor S. H. Dickson, Charleston, S. C., September 18, 1856.

A monument of intelligent and well applied research, almost without example. It is, indeed, in itself, a large library, and is destined to constitute the special resort as a book of reference, in the subject of which it treats, to all future time.

We have not time at present, engaged as we are, by day and by night, in the work of combating this very disease, now prevailing in our city, to do more than give this cursory notice of what we consider as undoubtedly the most able and erudite medical publication our country has yet produced. But in view of the startling fact, that this, the most malignant and unmanageable disease of modern times, has for several years been prevailing in our country to a greater extent than ever before; that it is no longer confined to either large or small cities, but penetrates country villages, plantations, and farmhouses; that it is treated with scarcely better success now than thirty or forty years ago; that there is vast mischief done by ignorant pretenders to knowledge in regard to the disease, and in view of the probability that a majority of southern physicians will be called upon to treat the disease, we trust that this able and comprehensive treatise will be very generally read in the south.—*Memphis Med. Recorder.*

BY THE SAME AUTHOR.

PNEUMONIA; its Supposed Connection, Pathological and Etiological, with Autumnal Fevers, including an Inquiry into the Existence and Morbid Agency of Malaria. In one handsome octavo volume, extra cloth, of 500 pages. $3 00.

LAWRENCE (W.), F. R. S., &c.

A TREATISE ON DISEASES OF THE EYE. A new edition, edited, with numerous additions, and 243 illustrations, by ISAAC HAYS, M. D., Surgeon to Will's Hospital, &c. In one very large and handsome octavo volume, of 950 pages, strongly bound in leather with raised bands. $6 00.

LUDLOW (J. L.), M. D.

A MANUAL OF EXAMINATIONS upon Anatomy, Physiology, Surgery, Practice of Medicine, Obstetrics, Materia Medica, Chemistry, Pharmacy, and Therapeutics. To which is added a Medical Formulary. Third edition, thoroughly revised and greatly extended and enlarged. With 370 illustrations. In one handsome royal 12mo. volume, leather, of 816 large pages $2 50.

We know of no better companion for the student during the hours spent in the lecture room, or to refresh, at a glance, his memory of the various topics *crammed* into his head by the various professors to whom he is compelled to listen.—*Western Lancet*, May, 1857.

LEHMANN (C. G.)

PHYSIOLOGICAL CHEMISTRY. Translated from the second edition by GEORGE E. DAY, M. D., F. R. S., &c., edited by R. E. ROGERS, M. D., Professor of Chemistry in the Medical Department of the University of Pennsylvania, with illustrations selected from Funke's Atlas of Physiological Chemistry, and an Appendix of plates. Complete in two large and handsome octavo volumes, extra cloth, containing 1200 pages, with nearly two hundred illustrations. $6 00.

The work of Lehmann stands unrivalled as the most comprehensive book of reference and information extant on every branch of the subject on which it treats.—*Edinburgh Journal of Medical Science.*

The most important contribution as yet made to Physiological Chemistry.—*Am. Journal Med. Sciences*, Jan. 1856.

BY THE SAME AUTHOR.

MANUAL OF CHEMICAL PHYSIOLOGY. Translated from the German, with Notes and Additions, by J. CHESTON MORRIS, M. D., with an Introductory Essay on Vital Force, by Professor SAMUEL JACKSON, M. D., of the University of Pennsylvania. With illustrations on wood. In one very handsome octavo volume, extra cloth, of 336 pages. $2 25.

From Prof. Jackson's Introductory Essay.

In adopting the handbook of Dr. Lehmann as a manual of Organic Chemistry for the use of the students of the University, and in recommending his original work of PHYSIOLOGICAL CHEMISTRY for their more mature studies, the high value of his researches, and the great weight of his authority in that important department of medical science are fully recognized.

LYONS (ROBERT D.), K. C. C.,

Late Pathologist in-chief to the British Army in the Crimea, &c.

A TREATISE ON FEVER; or, selections from a course of Lectures on Fever.

Being part of a course of Theory and Practice of Medicine. In one neat octavo volume, of 362 pages, extra cloth; $2 00. (*Just Issued.*)

We have great pleasure in recommending Dr. Lyons' work on *Fever* to the attention of the profession. It is a work which cannot fail to enhance the author's previous well-earned reputation, as a diligent, careful, and accurate observer.—*British Med. Journal*, March 2, 1861.

Taken as a whole we can recommend it in the highest terms as well worthy the careful perusal and study of every student and practitioner of medicine. We consider the work a most valuable addition to medical literature, and one destined to wield no little influence over the mind of the profession.—*Med. and Surg. Reporter*, May 4, 1861.

This is an admirable work upon the most remarkable and most important class of diseases to which mankind are liable.—*Med. Journ. of N. Carolina*, May, 1861.

MEIGS (CHARLES D.), M. D.,

Lately Professor of Obstetrics, &c. in the Jefferson Medical College, Philadelphia.

OBSTETRICS: THE SCIENCE AND THE ART. Fourth edition, revised

and improved. With one hundred and twenty-nine illustrations. In one beautifully printed octavo volume, leather, of seven hundred and thirty large pages. $4 00. (*Now Ready*, Feb. 1863.)

FROM THE AUTHOR'S PREFACE.

“In this edition I have endeavored to amend the work by changes in its form; by careful corrections of many expressions, and by a few omissions and some additions as to the text.

“The Student will find that I have recast the article on Placenta Prævia, which I was led to do out of my desire to notice certain new modes of treatment which I regarded as not only ill founded as to the philosophy of our department, but dangerous to the people.

“In changing the form of my work by dividing it into paragraphs or sections, numbered from 1 to 959, I thought to present to the reader a common-place book of the whole volume Such a table of contents ought to prove both convenient and useful to a Student while attending public lectures.”

A work which has enjoyed so extensive a reputation and has been received with such general favor, requires only the assurance that the author has labored assiduously to embody in his new edition whatever has been found necessary to render it fully on a level with the most advanced state of the subject. Both as a text-book for the student and as a reliable work of reference for the practitioner, it is therefore to be hoped that the volume will be found worthy a continuance of the confidence reposed in previous editions.

As an elementary treatise—concise, but, withal, clear and comprehensive—we know of no one better adapted for the use of the student; while the young practitioner will find in it a body of sound doctrine, and a series of excellent practical directions, adapted to all the conditions of the various forms of labor and their results, which he will be induced, we are persuaded, again and again to consult, and always with profit. It has seldom been our lot to peruse a work upon the subject, from which we have received greater satisfaction, and which we believe to be better calculated to communicate to the student correct and definite views upon the several topics embraced within the scope of its teachings.—*Am. Journ. Med. Sci.*

An author of established merit, a professor of Midwifery, and a practitioner of high reputation and immense experience—we may assuredly regard his work now before us as representing the most advanced state of obstetric science in America up to the time at which he writes. We consider Dr. Meigs' book as a valuable acquisition to obstetric literature, and one that will very much assist the practitioner under many circumstances of doubt and perplexity.—*The Dublin Quarterly Journal.*

These various heads are subdivided so well, so lucidly explained, that a good memory is all that is necessary in order to put the reader in possession of a thorough knowledge of this important subject. Dr. Meigs has conferred a great benefit on the profession in publishing this excellent work.—*St. Louis Medical and Surgical Journal.*

He has an earnest way with him, when speaking of the most elementary subjects, which fixes the attention and adds much value to the work as a text-book for students; indeed it is obviously the result of much practical acquaintance with the art of teaching.—*The British and Foreign Med.-Chirurg. Review.*

We are acquainted with no work on midwifery of greater practical value.—*Boston Med. & Surg. Journ.*

BY THE SAME AUTHOR. (*Just Issued.*)

WOMAN: HER DISEASES AND THEIR REMEDIES. A Series of Lectures to his Class.

Fourth and Improved edition. In one large and beautifully printed octavo volume, extra cloth, of over 700 pages. $3 60.

In other respects, in our estimation, too much cannot be said in praise of this work. It abounds with beautiful passages, and for conciseness, for originality, and for all that is commendable in a work on the diseases of females, it is not excelled, and probably not equalled in the English language. On the whole, we know of no work on the diseases of women which we can so cordially commend to the student and practitioner as the one before us.—*Ohio Med. and Surg. Journal.*

The body of the book is worthy of attentive consideration, and is evidently the production of a clever, thoughtful, and sagacious physician. Dr. Meigs's letters on the diseases of the external organs, contain many interesting and rare cases, and many instructive observations. We take our leave of Dr. Meigs, with a high opinion of his talents and originality.—*The British and Foreign Medico-Chirurgical Review.*

Every chapter is replete with practical instruction, and bears the impress of being the composition *of an acute and experienced* mind. There is a terse*ness, and at the same* time an accuracy in his de*scription of symptoms*, and in the rules for diagnosis, which cannot fail to recommend the volume to the attention of the reader.—*Ranking's Abstract.*

It contains a vast amount of practical knowledge, by one who has accurately observed and retained the experience of many years.—*Dublin Quarterly Journal.*

Full of important matter, conveyed in a ready and agreeable manner.—*St. Louis Med. and Surg. Jour.*

There is an off-hand fervor, a glow, and a warmheartedness infecting the effort of Dr. Meigs, which is entirely captivating, and which absolutely hurries the reader through from beginning to end. Besides, the book teems with solid instruction, and it shows the very highest evidence of ability, viz., the clearness with which the information is presented. We know of no better test of one's understanding a subject than the evidence of the power of lucidly explaining it. The most elementary, as well as the obscurest subjects, under the pencil of Prof. Meigs, are isolated and made to stand out in such bold relief, as to produce distinct impressions upon the mind and memory of the reader.—T Charleston Med. Journal.

MEIGS (CHARLES D.), M. D.,

Lately Professor of Obstetrics, &c., in Jefferson Medical College, Philadelphia.

ON THE NATURE, SIGNS, AND TREATMENT OF CHILDBED FEVER.

In a Series of Letters addressed to the Students of his Class. In one handsome octavo volume, extra cloth, of 365 pages. $2 50.

The instructive and interesting author of this work, whose previous labors have placed his countrymen under deep and abiding obligations, again challenges their admiration in the fresh and vigorous, attractive and racy pages before us. It is a delectable book. * * * This treatise upon childbed fevers will have an extensive sale, being destined, as it deserves, to find a place in the library of every practitioner who scorns to lag in the rear.—*Nashville Journal of Medicine and Surgery.*

BY THE SAME AUTHOR; WITH COLORED PLATES.

A TREATISE ON ACUTE AND CHRONIC DISEASES OF THE NECK OF THE UTERUS.

With numerous plates, drawn and colored from nature in the highest style of art. In one handsome octavo volume, extra cloth. $4 50.

MACLISE (JOSEPH), SURGEON.

SURGICAL ANATOMY.

Forming one volume, very large imperial quarto. With sixty-eight large and splendid Plates, drawn in the best style and beautifully colored. Containing one hundred and ninety Figures, many of them the size of life. Together with copious and explanatory letter-press. Strongly and handsomely bound in extra cloth, being one of the cheapest and best executed Surgical works as yet issued in this country. $11 00.

Gentlemen preparing for service in the field or hospital will find these plates of the highest practical value, either for consultation in emergencies or to refresh their recollection of the dissecting room.

⁂ The size of this work prevents its transmission through the post-office as a whole, but those who desire to have copies forwarded by mail, can receive them in five parts, done up in stout wrappers. Price $9 00.

One of the greatest artistic triumphs of the age in Surgical Anatomy.—*British American Medical Journal.*

No practitioner whose means will admit should fail to possess it.—*Ranking's Abstract.*

Too much cannot be said in its praise; indeed, we have not language to do it justice.—*Ohio Medical and Surgical Journal.*

The most accurately engraved and beautifully colored plates we have ever seen in an American book—one of the best and cheapest surgical works ever published.—*Buffalo Medical Journal.*

It is very rare that so elegantly printed, so well illustrated, and so useful a work, is offered at so moderate a price.—*Charleston Medical Journal.*

Its plates can boast a superiority which places them almost beyond the reach of competition.—*Medical Examiner.*

Country practitioners will find these plates of immense value.—*N. Y. Medical Gazette.*

A work which has no parallel in point of accuracy and cheapness in the English language.—*N. Y. Journal of Medicine.*

We are extremely gratified to announce to the profession the completion of this truly magnificent work, which, as a whole, certainly stands unrivalled, both for accuracy of drawing, beauty of coloring, and all the requisite explanations of the subject in hand.—*The New Orleans Medical and Surgical Journal.*

This is by far the ablest work on Surgical Anatomy that has come under our observation. We know of no other work that would justify a student, in any degree, for neglect of actual dissection. In those sudden emergencies that so often arise, and which require the instantaneous command of minute anatomical knowledge, a work of this kind keeps the details of the dissecting-room perpetually fresh in the memory.—*The Western Journal of Medicine and Surgery.*

MILLER (HENRY), M. D.,

Professor of Obstetrics and Diseases of Women and Children in the University of Louisville.

PRINCIPLES AND PRACTICE OF OBSTETRICS, &c.; including the Treatment of Chronic Inflammation of the Cervix and Body of the Uterus considered as a frequent cause of Abortion.

With about one hundred illustrations on wood. In one very handsome octavo volume, of over 600 pages, extra cloth. $3 75.

We congratulate the author that the task is done. We congratulate him that he has given to the medical public a work which will secure for him a high and permanent position among the standard authorities on the principles and practice of obstetrics. Congratulations are not less due to the medical profession of this country, on the acquisition of a treatise embodying the results of the studies, reflections, and experience of Prof. Miller.—*Buffalo Medical Journal.*

In fact, this volume must take its place among the standard systematic treatises on obstetrics; a position to which its merits justly entitle it.—*The Cincinnati Lancet and Observer.*

A most respectable and valuable addition to our home medical literature, and one reflecting credit alike on the author and the institution to which he is attached. The student will find in this work a most useful guide to his studies; the country practitioner, rusty in his reading, can obtain from its pages a fair résumé of the modern literature of the science; and we hope to see this American production generally consulted by the profession.—*Va. Med. Journal.*

MACKENZIE (W.), M. D.,

Surgeon Oculist in Scotland in ordinary to Her Majesty, &c. &c.

A PRACTICAL TREATISE ON DISEASES AND INJURIES OF THE EYE.

To which is prefixed an Anatomical Introduction explanatory of a Horizontal Section of the Human Eyeball, by THOMAS WHARTON JONES, F. R. S. From the Fourth Revised and Enlarged London Edition. With Notes and Additions by ADDINELL HEWSON, M. D., Surgeon to Wills Hospital, &c. &c. In one very large and handsome octavo volume, extra cloth, with plates and numerous wood-cuts. $5 25.

The treatise of Dr. Mackenzie indisputably holds the first place, and forms, in respect of learning and research, an Encyclopædia unequalled in extent by any other work of the kind, either English or foreign.—*Dixon on Diseases of the Eye.*

We consider it the duty of every one who has the love of his profession and the welfare of his patient at heart, to make himself familiar with this the most complete work in the English language upon the diseases of the eye.—*Med. Times and Gazette.*

MILLER (JAMES), F. R. S. E.,
Professor of Surgery in the University of Edinburgh, &c.

PRINCIPLES OF SURGERY. Fourth American, from the third and revised Edinburgh edition. In one large and very beautiful volume, extra cloth, of 700 pages, with two hundred and forty illustrations on wood. $3 75.

BY THE SAME AUTHOR.

THE PRACTICE OF SURGERY. Fourth American from the last Edinburgh edition. Revised by the American editor. Illustrated by three hundred and sixty-four engravings on wood. In one large octavo volume, extra cloth, of nearly 700 pages. $3 75.

No encomium of ours could add to the popularity of Miller's Surgery. Its reputation in this country is unsurpassed by that of any other work, and, when taken in connection with the author's *Principles of Surgery*, constitutes a whole, without reference to which no conscientious surgeon would be willing to practice his art.—*Southern Med. and Surg. Journal.*

It is seldom that two volumes have ever made so profound an impression in so short a time as the "Principles" and the "Practice" of Surgery by Mr. Miller—or so richly merited the reputation they have acquired. The author is an eminently sensible, practical, and well-informed man, who knows exactly what he is talking about and exactly how to talk it.—*Kentucky Medical Recorder.*

By the almost unanimous voice of the profession, his works, both on the principles and practice of surgery have been assigned the highest rank. If we were limited to but one work on surgery, that one should be Miller's, as we regard it as superior to all others.—*St. Louis Med. and Surg. Journal.*

The author has in this and his "Principles," presented to the profession one of the most complete and reliable systems of Surgery extant. His style of writing is original, impressive, and engaging, energetic, concise, and lucid. Few have the faculty of condensing so much in small space, and at the same time so persistently holding the attention. Whether as a text-book for students or a book of reference for practitioners, it cannot be too strongly recommended.—*Southern Journal of Med. and Physical Sciences.*

MORLAND (W. W.), M. D.,
Fellow of the Massachusetts Medical Society, &c.

DISEASES OF THE URINARY ORGANS; a Compendium of their Diagnosis, Pathology, and Treatment. With illustrations. In one large and handsome octavo volume, of about 600 pages, extra cloth. $3 50.

Taken as a whole, we can recommend Dr. Morland's compendium as a very desirable addition to the library of every medical or surgical practitioner.—*Brit and For. Med.-Chir. Rev.*, April, 1859.

Every medical practitioner whose attention has been to any extent attracted towards the class of diseases to which this treatise relates, must have often and sorely experienced the want of some full, yet concise recent compendium to which he could refer. This desideratum has been supplied by Dr. Morland, and it has been ably done. He has placed before us a full, judicious, and reliable digest. Each subject is treated with sufficient minuteness, yet in a succinct, narrational style, such as to render the work one of great interest, and one which will prove in the highest degree useful to the general practitioner.—*N. Y. Journ. of Medicine.*

BY THE SAME AUTHOR.

THE MORBID EFFECTS OF THE RETENTION IN THE BLOOD OF THE ELEMENTS OF THE URINARY SECRETION. Being the Dissertation to which the Fiske Fund Prize was awarded, July 11, 1861. In one small octavo volume, 83 pages, extra cloth. 75 cents.

MONTGOMERY (W. F.), M. D., M. R. I. A., &c.,
Professor of Midwifery in the King and Queen's College of Physicians in Ireland, &c.

AN EXPOSITION OF THE SIGNS AND SYMPTOMS OF PREGNANCY. With some other Papers on Subjects connected with Midwifery. From the second and enlarged English edition. With two exquisite colored plates, and numerous wood-cuts. In one very handsome octavo volume, extra cloth, of nearly 600 pages. $3 75.

A book unusually rich in practical suggestions.—*Am Journal Med. Sciences*, Jan. 1857.

These several subjects so interesting in themselves, and so important, every one of them, to the most delicate and precious of social relations, controlling often the honor and domestic peace of a family, the legitimacy of offspring, or the life of its parent, are all treated with an elegance of diction, fulness of illustrations, acuteness and justice of reasoning, unparalleled in obstetrics, and unsurpassed in medicine. The reader's interest can never flag, so fresh, and vigorous, and classical is our author's style; and one forgets, in the renewed charm of every page, that it, and every line, and every word has been weighed and reweighed through years of preparation; that this is of all others the book of Obstetric Law, on each of its several topics; on all points connected with pregnancy, to be everywhere received as a manual of special jurisprudence, at once announcing fact, affording argument, establishing precedent, and governing alike the juryman, advocate, and judge.—*N. A. Med.-Chir. Review.*

MOHR (FRANCIS), PH. D., AND REDWOOD (THEOPHILUS).

PRACTICAL PHARMACY. Comprising the Arrangements, Apparatus, and Manipulations of the Pharmaceutical Shop and Laboratory. Edited, with extensive Additions, by Prof. WILLIAM PROCTER, of the Philadelphia College of Pharmacy. In one handsomely printed octavo volume, extra cloth, of 570 pages, with over 500 engravings on wood. $2 75

MAYNE'S DISPENSATORY AND THERAPEUTICAL REMEMBRANCER. With every Practical Formula contained in the three British *Pharmacopœias. Edited*, with the addition of the *Formulæ of the U. S.* Pharmacopœia, by R. E. GRIFFITH, M. D 1 12mo. vol. ex. cl., 300 pp. 75 c.

MALGAIGNE'S OPERATIVE SURGERY, based on Normal and Pathological Anatomy. Translated from the French by FREDERICK BRITTAN, A. B., M. D. With numerous illustrations on wood. In one handsome octavo volume, extra cloth, of nearly six hundred pages. $2 25.

NEILL (JOHN), M. D.,

Surgeon to the Pennsylvania Hospital, &c.; and

FRANCIS GURNEY SMITH, M. D.,

Professor of Institutes of Medicine in the Pennsylvania Medical College.

AN ANALYTICAL COMPENDIUM OF THE VARIOUS BRANCHES OF MEDICAL SCIENCE; for the Use and Examination of Students. A new edition, revised and improved. In one very large and handsomely printed royal 12mo. volume, of about one thousand pages, with 374 wood-cuts. Strongly bound in leather, with raised bands. $3 25.

This work is again presented as eminently worthy of the favor with which it has hitherto been received. As a book for daily reference by the student requiring a guide to his more elaborate text-books, as a manual for preceptors desiring to stimulate their students by frequent and accurate examination, or as a source from which the practitioners of older date may easily and cheaply acquire a knowledge of the changes and improvement in professional science, its reputation is permanently established.

The best work of the kind with which we are acquainted.—*Med. Examiner.*

Having made free use of this volume in our examinations of pupils, we can speak from experience in recommending it as an admirable compend for students, and as especially useful to preceptors who examine their pupils. It will save the teacher much labor by enabling him readily to recall all of the points upon which his pupils should be examined. A work of this sort should be in the hands of every one who takes pupils into his office with a view of examining them; and this is unquestionably the best of its class.—*Transylvania Med. Journal.*

In the rapid course of lectures, where work for the students is heavy, and review necessary for an examination, a compend is not only valuable, but it is almost a *sine qua non.* The one before us is, in most of the divisions, the most unexceptionable of all books of the kind that we know of. The newest and soundest doctrines and the latest improvements and discoveries are explicitly, though concisely, laid before the student. There is a class to whom we very sincerely commend this cheap book as worth its weight in silver—that class is the graduates in medicine of more than ten years' standing, who have not studied medicine since. They will perhaps find out from it that the science is not exactly now what it was when they left it off.—*The Stethoscope.*

NELIGAN (J. MOORE), M. D., M. R. I. A., &c.

ATLAS OF CUTANEOUS DISEASES. In one beautiful quarto volume, extra cloth, with splendid colored plates, presenting nearly one hundred elaborate representations of disease. $4 50.

This beautiful volume is intended as a complete and accurate representation of all the varieties of Diseases of the Skin. While it can be consulted in conjunction with any work on Practice, it has especial reference to the author's "Treatise on Diseases of the Skin," so favorably received by the profession some years since. The publishers feel justified in saying that few more beautifully executed plates have ever been presented to the profession of this country.

Neligan's Atlas of Cutaneous Diseases supplies a long existent desideratum much felt by the largest class of our profession. It presents, in quarto size, 16 plates, each containing from 3 to 6 figures, and forming in all a total of 90 distinct representations of the different species of skin affections, grouped together in genera or families. The illustrations have been taken from nature, and have been copied with such fidelity that they present a striking picture of life; in which the reduced scale aptly serves to give, at a *coup d'œil*, the remarkable peculiarities of each individual variety. And while thus the disease is rendered more definable, there is yet no loss of proportion incurred by the necessary concentration. Each figure is highly colored, and so truthful has the artist been that the most fastidious observer could not justly take exception to the correctness of the execution of the pictures under his scrutiny.—*Montreal Med. Chronicle.*

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON DISEASES OF THE SKIN. Third American edition. In one neat royal 12mo. volume, extra cloth, of 334 pages. $1 00.

☞ The two volumes will be sent by mail on receipt of *Five Dollars.*

OWEN ON THE DIFFERENT FORMS OF THE SKELETON, AND OF THE TEETH. One vol. royal 12mo., extra cloth with numerous illustrations. $1 25

PIRRIE (WILLIAM), F. R. S. E.,

Professor of Surgery in the University of Aberdeen.

THE PRINCIPLES AND PRACTICE OF SURGERY. Edited by JOHN NEILL, M. D., Professor of Surgery in the Penna. Medical College, Surgeon to the Pennsylvania Hospital, &c. In one very handsome 8vo. volume, extra cloth, of 780 pages, with 316 illustrations. $3 75.

We know of no other surgical work of a reasonable size, wherein there is so much theory and practice, or where subjects are more soundly or clearly taught.—*The Stethoscope.*

Prof. Pirrie, in the work before us, has elaborately discussed the principles of surgery, and a safe and effectual practice predicated upon them. Perhaps no work upon this subject heretofore issued is so full upon the science of the art of surgery.—*Nashville Journal of Medicine and Surgery.*

PARKER (LANGSTON),

Surgeon to the Queen's Hospital, Birmingham.

THE MODERN TREATMENT OF SYPHILITIC DISEASES, BOTH PRIMARY AND SECONDARY; comprising the Treatment of Constitutional and Confirmed Syphilis, by a safe and successful method. With numerous Cases, Formulæ, and Clinical Observations. From the Third and entirely rewritten London edition. In one neat octavo volume, extra cloth, of 316 pages. $1 75.

PARRISH (EDWARD),

Lecturer on Practical Pharmacy and Materia Medica in the Pennsylvania Academy of Medicine, &c.

AN INTRODUCTION TO PRACTICAL PHARMACY. Designed as a Text-Book for the Student, and as a Guide for the Physician and Pharmaceutist. With many Formulæ and Prescriptions. Third edition, greatly improved. In one handsome octavo volume, of about 700 pages, with several hundred Illustrations. (*Preparing for early publication.*)

Though for some time out of print, the appearance of a new edition of this work has been delayed for the purpose of embodying in it the results of the new U. S. Pharmacopœia. The approaching publication of this latter will enable the author to complete his revision at an early period, when those who have been waiting for the work may rely on obtaining a volume thoroughly on a level with the most advanced condition of pharmaceutical science.

The favor with which the work has thus far been received shows that the author was not mistaken in his estimate of the want of a treatise which should serve as a practical text-book for all engaged in preparing and dispensing medicines. Such a guide was indispensable not only to the educated pharmaceutist, but also to that large class of practitioners throughout the country who are obliged to compound their own prescriptions, and who during their collegiate course have no opportunity of obtaining a practical familiarity with the necessary processes and manipulations. The rapid exhaustion of two large editions is evidence that the author has succeeded in thoroughly carrying out his object, and that the profession may rely that nothing shall be wanting to render the new edition worthy a continuance of the confidence hitherto bestowed upon the work.

All that we can say of it is that to the practising physician, and especially the country physician, who is generally his own apothecary, there is hardly any book that might not better be dispensed with. It is at the same time a dispensatory and a pharmacy.—*Louisville Review.*

A careful examination of this work enables us to speak of it in the highest terms, as being the best treatise on practical pharmacy with which we are acquainted, and an invaluable *vade-mecum*, not only to the apothecary and to those practitioners who are accustomed to prepare their own medicines, but to every medical man and medical student.—*Boston Med. and Surg. Journal.*

This is altogether one of the most useful books we have seen. It is just what we have long felt to be needed by apothecaries, students, and practitioners of medicine, most of whom in this country have to put up their own prescriptions. It bears, upon every page, the impress of practical knowledge, conveyed in a plain common sense manner, and adapted to the comprehension of all who may read it. No detail has been omitted, however trivial it may seem, although really important to the dispenser of medicine.—*Southern Med. and Surg. Journal.*

That Edward Parrish, in writing a book upon *practical* Pharmacy some few years ago—one eminently original and unique—did the medical and pharmaceutical professions a great and valuable service, no one, we think, who has had access to its pages will deny; doubly welcome, then, is this new edition, containing the added results of his recent and rich experience as an observer, teacher, and practical operator in the pharmaceutical laboratory. The excellent plan of the first is more thoroughly, and in detail, carried out in this edition.—*Peninsular Med. Journal*, Jan. 1860.

Of course, all apothecaries who have not already a copy of the first edition will procure one of this; it is, therefore, to physicians residing in the country and in small towns, who cannot avail themselves of the skill of an educated pharmaceutist, that we would especially commend this work. In it they will find all that they desire to know, and should know, but very little of which they do really know in reference to this important collateral branch of their profession; for it is a well established fact, that, in the education of physicians, while the science of medicine is generally well taught, very little attention is paid to the art of preparing them for use, and we know not how this defect can be so well remedied as by procuring and consulting Dr. Parrish's excellent work.—*St. Louis Med. Journal*, Jan. 1860.

We know of no work on the subject which would be more indispensable to the physician or student desiring information on the subject of which it treats. With Griffith's "Medical Formulary" and this, the practising physician would be supplied with nearly or quite all the most useful information on the subject.—*Charleston Med. Jour. and Review*, Jan. 1860.

PEASLEE (E. R.), M. D.,

Professor of Physiology and General Pathology in the New York Medical College.

HUMAN HISTOLOGY, in its relations to Anatomy, Physiology, and Pathology; for the use of Medical Students. With four hundred and thirty-four illustrations. In one handsome octavo volume, extra cloth, of over 600 pages. $3 75.

It embraces a library upon the topics discussed within itself, and is just what the teacher and learner need. We have not only the whole subject of Histology, interesting in itself, ably and fully discussed, but what is of infinitely greater interest to the student, because of greater practical value, are its relations to Anatomy, Physiology, and Pathology, which are here fully and satisfactorily set forth.—*Nashville Journ. of Med. and Surgery.*

We would recommend it as containing a summary of all that is known of the important subjects which it treats; of all that is in the great works of Simon and Lehmann, and the organic chemists in general. Master this one volume, we would say to the medical student and practitioner—master this book and you know all that is known of the great fundamental principles of medicine, and we have no hesitation in saying that it is an honor to the American medical profession.—*St. Louis Med. and Surg. Journal.*

ROKITANSKY (CARL), M. D.,

Curator of the Imperial Pathological Museum, and Professor at the University of Vienna, &c.

A MANUAL OF PATHOLOGICAL ANATOMY. Four volumes, octavo, bound in two, extra cloth, of about 1200 pages. Translated by W. E. Swaine, Edward Sieveking, C. H. Moore, and G. E. Day. $5 50.

The profession is too well acquainted with the reputation of Rokitansky's work to need our assurance that this is one of the most profound, thorough, and valuable books ever issued from the medical press. It is *sui generis*, and has no standard of comparison. It is only necessary to announce that it is issued in a form as cheap as is compatible with its size and preservation, and its sale follows as a matter of course. No library can be called complete without it.—*Buffalo Med. Journal.*

An attempt to give our readers any adequate idea of the vast amount of instruction accumulated in these volumes, would be feeble and hopeless. The effort of the distinguished author to concentrate in a small space his great fund of knowledge, has so charged his text with valuable truths, that any attempt of a reviewer to epitomize is at once paralyzed, and must end in a failure.—*Western Lancet.*

As this is the highest source of knowledge upon the important subject of which it treats, no real student can afford to be without it. The American publishers have entitled themselves to the thanks of the profession of their country, for this timeous and beautiful edition.—Nashville Journal of Medicine

RIGBY (EDWARD), M. D.,

Senior Physician to the General Lying-in Hospital, &c.

A SYSTEM OF MIDWIFERY. With Notes and Additional Illustrations. Second American Edition. One volume octavo, extra cloth, 422 pages. $2 50.

BY THE SAME AUTHOR.

ON THE CONSTITUTIONAL TREATMENT OF FEMALE DISEASES. In one neat royal 12mo. volume, extra cloth, of about 250 pages. $1 00.

RAMSBOTHAM (FRANCIS H.), M. D.

THE PRINCIPLES AND PRACTICE OF OBSTETRIC MEDICINE AND SURGERY, in reference to the Process of Parturition. A new and enlarged edition, thoroughly revised by the Author. With Additions by W. V. KEATING, M. D., Professor of Obstetrics, &c., in the Jefferson Medical College, Philadelphia. In one large and handsome imperial octavo volume, of 650 pages, strongly bound in leather, with raised bands; with sixty-four beautiful Plates, and numerous Wood-cuts in the text, containing in all nearly 200 large and beautiful figures. $5 50.

From Prof. Hodge, of the University of Pa.

To the American public, it is most valuable, from its intrinsic undoubted excellence, and as being the best authorized exponent of British Midwifery. Its circulation will, I trust, be extensive throughout our country.

It is unnecessary to say anything in regard to the utility of this work. It is already appreciated in our country for the value of the matter, the clearness of its style, and the fulness of its illustrations. To the physician's library it is indispensable, while to the student as a text-book, from which to extract the material for laying the foundation of an education on obstetrical science, it has no superior.—*Ohio Med. and Surg. Journal.*

The publishers have secured its success by the truly elegant style in which they have brought it out, excelling themselves in its production, especially in its plates. It is dedicated to Prof. Meigs, and has the emphatic endorsement of Prof. Hodge, as the best exponent of British Midwifery. We know of no text-book which deserves in all respects to be more highly recommended to students, and we could wish to see it in the hands of every practitioner, for they will find it invaluable for reference.—*Med. Gazette.*

RICORD (P.), M. D.

A TREATISE ON THE VENEREAL DISEASE. By JOHN HUNTER, F.R.S. With copious Additions, by PH. RICORD, M.D. Translated and Edited, with Notes, by FREEMAN J. BUMSTEAD. M. D., Lecturer on Venereal at the College of Physicians and Surgeons, New York. Second edition, revised, containing a *résumé* of RICORD'S RECENT LECTURES ON CHANCRE. In one handsome octavo volume, extra cloth, of 550 pages, with eight plates. $3 25.

Every one will recognize the attractiveness and value which this work derives from thus presenting the opinions of these two masters side by side. But, it must be admitted, what has made the fortune of the book, is the fact that it contains the "most complete embodiment of the veritable doctrines of the Hôpital du Midi," which has ever been made public. In conclusion we can say that this is incontestably the best treatise on syphilis with which we are acquainted, and, as we do not often employ the phrase, we may be excused for expressing the hope that it may find a place in the library of every physician.—*Virginia Med. and Surg. Journal.*

BY THE SAME AUTHOR.

RICORD'S LETTERS ON SYPHILIS. Translated by W. P. LATTIMORE, M. D. In one neat octavo volume, of 270 pages, extra cloth. $2 00.

ROYLE'S MATERIA MEDICA AND THERAPEUTICS; including the Preparations of the Pharmacopœias of London, Edinburgh, Dublin, and of the United States. With many new medicines. Edited by JOSEPH CARSON, M. D. With ninety-eight illustrations. In one large octavo volume, extra cloth, of about 700 pages. $3 00.

SMITH (HENRY H.), M. D., AND HORNER (WILLIAM E.), M. D.

AN ANATOMICAL ATLAS, illustrative of the Structure of the Human Body. In one volume, large imperial octavo, extra cloth, with about six hundred and fifty beautiful figures. $3 50.

The plan of this Atlas, which renders it so peculiarly convenient for the student, and its superb artistical execution, have been already pointed out. We must congratulate the student upon the completion of this Atlas, as it is the most convenient work of the kind that has yet appeared; and we must add, the very beautiful manner in which it is "got up" is so creditable to the country as to be flattering to our national pride.—*American Medical Journal.*

SHARPEY (WILLIAM), M. D., JONES QUAIN, M. D., AND RICHARD QUAIN, F. R. S., &c.

HUMAN ANATOMY. Revised, with Notes and Additions, by JOSEPH LEIDY, M. D., Professor of Anatomy in the University of Pennsylvania. Complete in two large octavo volumes, extra cloth, of about thirteen hundred pages. With over 500 illustrations. $6 00.

SOLLY ON THE HUMAN BRAIN; its Structure, Physiology, and Diseases. From the Second and much enlarged London edition. In one octavo volume, extra cloth, of 500 pages, with 120 wood-cuts. $2 00.

SKEY'S OPERATIVE SURGERY. In one very handsome octavo volume, extra cloth, of over 650 pages, with about one hundred wood-cuts. $3 25.

SIMON'S GENERAL PATHOLOGY, as conducive to the Establishment of Rational Principles for the prevention and Cure of Disease. In one octavo volume, extra cloth, of 212 pages. $1 25.

STILLE (ALFRED), M. D.

THERAPEUTICS AND MATERIA MEDICA; a Systematic Treatise on the Action and Uses of Medicinal Agents, including their Description and History. In two large and handsome octavo volumes, of 1789 pages, leather. $8 00.

This work is designed especially for the student and practitioner of medicine, and treats the various articles of the Materia Medica from the point of view of the bedside, and not of the shop or of the lecture-room. While thus endeavoring to give all practical information likely to be useful with respect to the employment of special remedies in special affections, and the results to be anticipated from their administration, a copious Index of Diseases and their Remedies renders the work eminently fitted for reference by showing at a glance the different means which have been employed, and enabling the practitioner to extend his resources in difficult cases with all that the experience of the profession has suggested.

Rarely, indeed have we had submitted to us a work on medicine so ponderous in its dimensions as that now before us, and yet so fascinating in its contents. It is, therefore, with a peculiar gratification that we recognize in Dr. Stillé the possession of many of those more distinguished qualifications which entitle him to approbation, and which justify him in coming before his medical brethren as an instructor. A comprehensive knowledge, tested by a sound and penetrating judgment, joined to a love of progress—which a discriminating spirit of inquiry has tempered so as to accept nothing new because it is new, and abandon nothing old because it is old, but which estimates either according to its relations to a just logic and experience—manifests itself everywhere, and gives to the guidance of the author all the assurance of safety which the difficulties of his subject can allow. In conclusion, we earnestly advise our readers to ascertain for themselves, by a study of Dr. Stillé's volumes, the great value and interest of the stores of knowledge they present. We have pleasure in referring rather to the ample treasury of undoubted truths, the real and assured conquest of medicine, accumulated by Dr. Stillé in his pages; and commend the sum of his labors to the attention of our readers, as alike honorable to our science, and creditable to the zeal, the candor, and the judgment of him who has garnered the whole so carefully.—*Edinburgh Med. Journal*.

Our expectations of the value of this work were based on the well-known reputation and character of the author as a man of scholarly attainments, an elegant writer, a candid inquirer after truth, and a philosophical thinker; we knew that the task would be conscientiously performed, and that few, if any, among the distinguished medical teachers in this country are better qualified than he to prepare a systematic treatise on therapeutics in accordance with the present requirements of medical science. Our preliminary examination of the work has satisfied us that we were not mistaken in our anticipations.—*New Orleans Medical News*, March, 1860.

The most recent authority is the one last mentioned, Stillé. His great work on "Materia Medica and Therapeutics," published last year, in two octavo volumes, of some sixteen hundred pages, while it embodies the results of the labor of others up to the time of publication, is enriched with a great amount of original observation and research. We would draw attention, by the way, to the very convenient mode in which the *Index* is arranged in this work. There is first an "Index of Remedies;" next an "Index of Diseases and their Remedies." Such an arrangement of the Indices, in our opinion, greatly enhances the practical value of books of this kind. In tedious, obstinate cases of disease, where we have to try one remedy after another until our stock is pretty nearly exhausted, and we are almost driven to our wit's end, such an index as the second of the two just mentioned, is precisely what we want.—*London Med. Times and Gazette*, April, 1861.

We think this work will do much to obviate the reluctance to a thorough investigation of this branch of scientific study, for in the wide range of medical literature treasured in the English tongue, we shall hardly find a work written in a style more clear and simple, conveying forcibly the facts taught, and yet free from turgidity and redundancy. There is a fascination in its pages that will insure to it a wide popularity and attentive perusal, and a degree of usefulness not often attained through the influence of a single work. The author has much enhanced the practical utility of his book by passing briefly over the physical, botanical, and commercial history of medicines, and directing attention chiefly to their physiological action, and their application for the amelioration or cure of disease. He ignores hypothesis and theory which are so alluring to many medical writers, and so liable to lead them astray, and confines himself to such facts as have been tried in the crucible of experience.—*Chicago Medical Journal*.

SIMPSON (J. Y.), M. D.,

Professor of Midwifery, &c., in the University of Edinburgh, &c.

CLINICAL LECTURES ON THE DISEASES OF WOMEN. With numerous illustrations. In one handsome octavo volume, of over 500 pages, extra cloth, $3 00. (*Now Ready*, 1863.)

This valuable work having passed through the columns of "THE MEDICAL NEWS AND LIBRARY" for 1860, 1861, and 1862, is now completed, and may be had separate in one handsome volume.

These Lectures were delivered by Professor Simpson at the Royal Infirmary of Edinburgh and were published in the "London Medical Times and Gazette" during the years 1859, 1860, and 1861. The distinguished reputation of the author, and the valuable practical matter contained in the Lectures have seemed to entitle them to a more permanent form than the evanescent pages of a periodical. Embracing a wide range of subjects, and each one elaborately treated and complete in itself, the volume can hardly fail to prove a valuable addition to the library of the practising physician.

The principal topics embraced in the Lectures are Vesico-Vaginal Fistula, Cancer of the Uterus, Treatment of Carcinoma by Caustics, Dysmenorrhœa, Amenorrhœa, Closures, Contractions, &c., of the Vagina, Vulvitis, Causes of Death after Surgical Operations, Surgical Fever, Phlegmasia Dolens, Coccyodinia, Pelvic Cellulitis, Pelvic Hæmatoma, Spurious Pregnancy, Ovarian Dropsy, Ovariotomy, Cranioclasm, Diseases of the Fallopian Tubes, Puerperal Mania, Sub-Involution and Super-Involution of the Uterus, &c. &c.

As a series of monographs on these important topics—many of which receive little attention in the ordinary text-books—elucidated with the extensive experience and readiness of resource for which Professor Simpson is so distinguished, there are few practitioners who will not find in its pages matter of the utmost importance in the treatment of obscure and difficult cases.

SALTER (H. H.), M. D.

ASTHMA; its Pathology, Causes, Consequences, and Treatment. (*Now publishing in the* "Medical News and Library" for 1863.) To form one volume, 8vo.

SARGENT (F. W.), M. D.

ON BANDAGING AND OTHER OPERATIONS OF MINOR SURGERY. New edition, with an additional chapter on Military Surgery. One handsome royal 12mo. vol., of nearly 400 pages, with 184 wood cuts. Extra cloth, $1 50. (*Now Ready.*)

The value of this work as a handy and convenient manual for surgeons engaged in active duty, has induced the publishers to render it more complete for those purposes by the addition of a chapter on gun-shot wounds and other matters peculiar to military surgery. In its present form, therefore, with no increase in price, it will be found a very cheap and convenient vade-mecum for consultation and reference in the daily exigencies of military as well as civil practice.

We consider that no better book could be placed in the hands of an hospital dresser, or the young surgeon, whose education in this respect has not been perfected. We most cordially commend this volume as one which the medical student should most closely study, to perfect himself in these minor surgical operations in which neatness and dexterity are so much required, and on which a great portion of his reputation as a future surgeon must evidently rest. And to the surgeon in practice it must prove itself a valuable volume, as instructive on many points which he may have forgotten.—*British American Journal*, May, 1862.

The instruction given upon the subject of *Bandaging*, is alone of great value, and while the author modestly proposes to instruct the students of medicine, and the younger physicians, we will say that experienced physicians will obtain many exceedingly valuable suggestions by its perusal. It will be found one of the most satisfactory manuals for reference in the field, or hospital yet published; thoroughly adapted to the wants of Military surgeons, and at the same time equally useful for ready and convenient reference by surgeons everywhere.—*Buffalo Med. and Surg. Journal*, June, 1862.

SMITH (W. TYLER), M. D.,

Physician Accoucheur to St. Mary's Hospital, &c.

ON PARTURITION, AND THE PRINCIPLES AND PRACTICE OF OBSTETRICS. In one royal 12mo. volume, extra cloth, of 400 pages. $1 25.

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON THE PATHOLOGY AND TREATMENT OF LEUCORRHŒA. With numerous illustrations. In one very handsome octavo volume, extra cloth, of about 250 pages. $1 50.

TANNER (T. H.), M. D.,

Physician to the Hospital for Women, &c.

A MANUAL OF CLINICAL MEDICINE AND PHYSICAL DIAGNOSIS. To which is added The Code of Ethics of the American Medical Association. Second American Edition. In one neat volume, small 12mo., extra cloth, 87½ cents.

TAYLOR (ALFRED S.), M. D., F. R. S.,

Lecturer on Medical Jurisprudence and Chemistry in Guy's Hospital.

MEDICAL JURISPRUDENCE. Fifth American, from the seventh improved and enlarged London edition. With Notes and References to American Decisions, by EDWARD HARTSHORNE, M. D. In one large 8vo. volume, extra cloth, of over 700 pages. $3 25.

This standard work having had the advantage of two revisions at the hands of the author since the appearance of the last American edition, will be found thoroughly revised and brought up completely to the present state of the science. As a work of authority, it must therefore maintain its position, both as a text-book for the student, and a compendious treatise to which the practitioner can at all times refer in cases of doubt or difficulty.

No work upon the subject can be put into the hands of students either of law or medicine which will engage them more closely or profitably; and none could be offered to the busy practitioner of either calling, for the purpose of casual or hasty reference, that would be more likely to afford the aid desired. We therefore recommend it as the best and safest manual for daily use.—*American Journal of Medical Sciences.*

It is not excess of praise to say that the volume before us is the very best treatise extant on Medical Jurisprudence. In saying this, we do not wish to be understood as detracting from the merits of the excellent works of Beck, Ryan, Traill, Guy, and others; but in interest and value we think it must be conceded that Taylor is superior to anything that has preceded it.—*N. W. Medical and Surg. Journal*

It is at once comprehensive and eminently practical, and by universal consent stands at the head of American and British legal medicine. It should be in the possession of every physician, as the subject is one of great and increasing importance to the public as well as to the profession.—*St. Louis Med. and Surg. Journal.*

This work of Dr. Taylor's is generally acknowledged to be one of the ablest extant on the subject of medical jurisprudence. It is certainly one of the most attractive books that we have met with; supplying so much both to interest and instruct, that we do not hesitate to affirm that after having once commenced its perusal, few could be prevailed upon to desist before completing it. In the last London edition, all the newly observed and accurately recorded facts have been inserted, including much that is recent of Chemical, Microscopical, and Pathological research, besides papers on numerous subjects never before published.—*Charleston Med. Journal and Review.*

BY THE SAME AUTHOR.

ON POISONS, IN RELATION TO MEDICAL JURISPRUDENCE AND MEDICINE. Second American, from a second and revised London edition. In one large octavo volume, of 755 pages, extra cloth. $3 50.

Mr. Taylor's position as the leading medical jurist of England, has conferred on him extraordinary advantages in acquiring experience on these subjects, nearly all cases of moment being referred to him for examination, as an expert whose testimony is generally accepted as final. The results of his labors, therefore, as gathered together in this volume, carefully weighed and sifted, and presented in the clear and intelligible style for which he is noted, may be received as an acknowledged authority, and as a guide to be followed with implicit confidence.

BY THE SAME AUTHOR AND WM. BRANDE.

CHEMISTRY. In one volume 8vo. See "BRANDE," p. 8.

TODD (ROBERT BENTLEY), M. D., F. R. S.,
Professor of Physiology in King's College, London; and

WILLIAM BOWMAN, F. R. S.,
Demonstrator of Anatomy in King's College, London.

THE PHYSIOLOGICAL ANATOMY AND PHYSIOLOGY OF MAN. With about three hundred large and beautiful illustrations on wood. Complete in one large octavo volume, of 950 pages, extra cloth. Price $4 50.

It is more concise than Carpenter's Principles, and more modern than the accessible edition of Müller's Elements; its details are brief, but sufficient; its descriptions vivid; its illustrations exact and copious; and its language terse and perspicuous.—*Charleston Med. Journal.*

A magnificent contribution to British medicine, and the American physician who shall fail to peruse it, will have failed to read one of the most instructive books of the nineteenth century.—*N. O. Med. and Surg. Journal.*

TODD (R. B.) M. D., F. R. S., &c.

CLINICAL LECTURES ON CERTAIN DISEASES OF THE URINARY ORGANS AND ON DROPSIES. In one octavo volume, 284 pages, extra cloth. $1 50.

BY THE SAME AUTHOR.

CLINICAL LECTURES ON CERTAIN ACUTE DISEASES. In one neat octavo volume, of 320 pages, extra cloth. $1 75.

TOYNBEE (JOSEPH), F. R. S.,
Aural Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital.

A PRACTICAL TREATISE ON DISEASES OF THE EAR; their Diagnosis, Pathology, and Treatment. Illustrated with one hundred engravings on wood. In one very handsome octavo volume, extra cloth, $3 00.

The work is a model of its kind, and every page and paragraph of it are worthy of the most thorough study. Considered all in all—as an original work, well written, philosophically elaborated, and happily illustrated with cases and drawings—it is by far the ablest monograph that has ever appeared on the anatomy and diseases of the ear, and one of the most valuable contributions to the art and science of surgery in the nineteenth century.—*N. Amer. Medico-Chirurg Review*, Sept. 1860.

We are speaking within the limits of modest acknowledgment, and with a sincere and unbiassed judgment, when we affirm that as a treatise on Aural Surgery, it is without a rival in our language or any other.—*Charleston Med. Journ. and Rev.*, Sept. 1860.

The work of Mr. Toynbee is undoubtedly, upon the whole, the most valuable production of the kind in any language. The author has long been known by his numerous monographs upon subjects connected with diseases of the ear, and is now regarded as the highest authority on most points in his department of science. Mr. Toynbee's work, as we have already said, is undoubtedly the most reliable guide for the study of the diseases of the ear in any language, and should be in the library of every physician.—*Chicago Med. Journal*, July, 1860.

WILLIAMS (C. J. B.), M. D., F. R. S.,
Professor of Clinical Medicine in University College, London, &c.

PRINCIPLES OF MEDICINE. An Elementary View of the Causes, Nature, Treatment, Diagnosis, and Prognosis of Disease; with brief remarks on Hygienics, or the preservation of health. A new American, from the third and revised London edition. In one octavo volume, extra cloth, of about 500 pages. $2 50.

WHAT TO OBSERVE

AT THE BEDSIDE AND AFTER DEATH, IN MEDICAL CASES. Published under the authority of the London Society for Medical Observation. A new American, from the second and revised London edition. In one very handsome volume, royal 12mo., extra cloth. $1 00.

To the observer who prefers accuracy to blunders and precision to carelessness, this little book is invaluable.—*N. H. Journal of Medicine.*

One of the finest aids to a young practitioner we have ever seen.—*Peninsular Journal of Medicine.*

WALSHE (W. H.), M. D.,
Professor of the Principles and Practice of Medicine in University College, London, &c.

A PRACTICAL TREATISE ON DISEASES OF THE LUNGS; including the Principles of Physical Diagnosis. Third American, from the third revised and much enlarged London edition. In one vol. octavo, of 468 pages. extra cloth. $2 25.

The present edition has been carefully revised and much enlarged, and may be said in the main to be rewritten. Descriptions of several diseases, previously omitted, are now introduced; an effort has been made to bring the description of anatomical characters to the level of the wants of the practical physician; and the diagnosis and prognosis of each complaint are more completely considered. The sections on TREATMENT and the Appendix have, especially, been largely extended.—*Author's Preface.*

BY THE SAME AUTHOR.

A PRACTICAL TREATISE ON THE DISEASES OF THE HEART AND GREAT VESSELS, including the Principles of Physical Diagnosis. Third American, from the third revised and much enlarged London edition. In one handsome octavo volume of 420 pages, extra cloth. $2 25.

The present edition has been carefully revised; much new matter has been added, and the entire work in a measure remodelled. Numerous facts and discussions, more or less completely novel, will be found in the description of the principles of physical diagnosis; but the chief additions have been made in the practical portions of the book. Several affections, of which little or no account had been given in the previous editions, are now treated of in detail.—*Author's Preface.*

New and much enlarged edition.

WATSON (THOMAS), M. D., &c.,

Late Physician to the Middlesex Hospital, &c.

LECTURES ON THE PRINCIPLES AND PRACTICE OF PHYSIC.

Delivered at King's College, London. A new American, from the last revised and enlarged English edition, with Additions, by D. FRANCIS CONDIE, M. D., author of "A Practical Treatise on the Diseases of Children," &c. With one hundred and eighty-five illustrations on wood. In one very large and handsome volume, imperial octavo, of over 1200 closely printed pages in small type; the whole strongly bound in leather, with raised bands. Price $5 00.

That the high reputation of this work might be fully maintained, the author has subjected it to a thorough revision; every portion has been examined with the aid of the most recent researches in pathology, and the results of modern investigations in both theoretical and practical subjects have been carefully weighed and embodied throughout its pages. The watchful scrutiny of the editor has likewise introduced whatever possesses immediate importance to the American physician in relation to diseases incident to our climate which are little known in England, as well as those points in which experience here has led to different modes of practice; and he has also added largely to the series of illustrations, believing that in this manner valuable assistance may be conveyed to the student in elucidating the text. The work will, therefore, be found thoroughly on a level with the most advanced state of medical science on both sides of the Atlantic.

The additions which the work has received are shown by the fact that notwithstanding an enlargement in the size of the page, more than two hundred additional pages have been necessary to accommodate the two large volumes of the London edition (which sells at ten dollars), within the compass of a single volume, and in its present form it contains the matter of at least three ordinary octavos. Believing it to be a work which should lie on the table of every physician, and be in the hands of every student, the publishers have put it at a price within the reach of all, making it one of the cheapest books as yet presented to the American profession, while at the same time the beauty of its mechanical execution renders it an exceedingly attractive volume.

The fourth edition now appears, so carefully revised, as to add considerably to the value of a book already acknowledged, wherever the English language is read, to be beyond all comparison the best systematic work on the Principles and Practice of Physic in the whole range of medical literature. Every lecture contains proof of the extreme anxiety of the author to keep pace with the advancing knowledge of the day One scarcely knows whether to admire most the pure, simple, forcible English—the vast amount of useful practical information condensed into the Lectures—or the manly, kind-hearted, unassuming character of the lecturer shining through his work.—*Lond. Med. Times.*

Thus these admirable volumes come before the profession in their fourth edition, abounding in those distinguished attributes of moderation, judgment, erudite cultivation, clearness, and eloquence, with which they were from the first invested, but yet richer than before in the results of more prolonged observation, and in the able appreciation of the latest advances in pathology and medicine by one of the most profound medical thinkers of the day.—*London Lancet.*

The lecturer's skill, his wisdom, his learning, are equalled by the ease of his graceful diction, his eloquence, and the far higher qualities of candor, of courtesy, of modesty, and of generous appreciation of merit in others.—*N. A. Med -Chir Review.* ,

Watson's unrivalled, perhaps unapproachable work on Practice—the copious additions made to which (the fourth edition) have given it all the novelty and much of the interest of a new book.—*Charleston Med. Journal.*

Lecturers, practitioners, and students of medicine will equally hail the reappearance of the work of Dr. Watson in the form of a new—a fourth—edition. We merely do justice to our own feelings, and, we are sure, of the whole profession, if we thank him for having, in the trouble and turmoil of a large practice, made leisure to supply the hiatus caused by the exhaustion of the third edition. For Dr. Watson has not merely caused the lectures to be reprinted, but scattered through the whole work we find additions or alterations which prove that the author has in every way sought to bring up his teaching to the level of the most recent acquisitions in science.—*Brit. and For Medico-Chir. Review*

New and much enlarged edition.

WILSON (ERASMUS), F. R. S.

A SYSTEM OF HUMAN ANATOMY, General and Special.

A new and revised American from the last and enlarged English Edition. Edited by W. H. GOBRECHT, M. D., Professor of Anatomy in the Pennsylvania Medical College, &c. Illustrated with three hundred and ninety-seven engravings on wood. In one large and exquisitely printed octavo volume, of over 600 large pages; leather. $3 75.

The publishers trust that the well earned reputation so long enjoyed by this work will be more than maintained by the present edition. Besides a very thorough revision by the author, it has been most carefully examined by the editor, and the efforts of both have been directed to introducing everything which increased experience in its use has suggested as desirable to render it a complete text-book for those seeking to obtain or to renew an acquaintance with Human Anatomy. The amount of additions which it has thus received may be estimated from the fact that the present edition contains over one-fourth more matter than the last, rendering a smaller type and an enlarged page requisite to keep the volume within a convenient size. The editor has exercised the utmost caution to obtain entire accuracy in the text, and has largely increased the number of illustrations, of which there are about one hundred and fifty more in this edition than in the last, thus bringing distinctly before the eye of the student everything of interest or importance.

It may be recommended to the student as no less distinguished by its accuracy and clearness of description than by its typographical elegance. The wood-cuts are exquisite.—*Brit. and For. Medical Review.*

An elegant edition of one of the most useful and accurate systems of anatomical science which has been issued from the press The illustrations are really beautiful. In its style the work is extremely concise and intelligible. No one can possibly take up this volume without being struck with the great beauty of its mechanical execution, and the clearness of the descriptions which it contains is equally evident. Let students, by all means examine the claims of this work on their notice, before they purchase a text-book of the vitally important science which this volume so fully and easily unfolds.—*Lancet.*

We regard it as the best system now extant for students.—*Western Lancet.*

It therefore receives our highest commendation.—*Southern Med. and Surg. Journal.*

WILSON (ERASMUS), F. R. S.

ON DISEASES OF THE SKIN. Fifth American, from the Fifth enlarged London edition. In one handsome octavo volume, of nearly 700 large pages, with illustrations on wood, extra cloth. $3 25. (*Now Ready*, May, 1863.)

This classical work, which for twenty years has occupied the position of the leading authority in the English language on its important subject, has just received a thorough revision at the hands of the author, and is now presented as embodying the results of the latest investigations and experience on all matters connected with diseases of the skin. The increase in the size of the work shows the industry of the author, and his determination that it shall maintain the position which it has acquired as thoroughly on a level with the most advanced condition of medical science.

A few notices of the last edition are appended.

The writings of Wilson, upon diseases of the skin, are by far the most scientific and practical that have ever been presented to the medical world on this subject. The present edition is a great improvement on all its predecessors. To dwell upon all the great merits and high claims of the work before us, *seriatim*, would indeed be an agreeable service; it would be a mental homage which we could freely offer, but we should thus occupy an undue amount of space in this *Journal*. We will, however, look at some of the more salient points with which it abounds, and which make it incomparably superior to all other treatises on the subject of dermatology. No mere speculative views are allowed a place in this volume, which, without a doubt will, for a very long period, be acknowledged as the chief standard work on dermatology. The principles of an enlightened and rational therapeia are introduced on every appropriate occasion.—*Am. Jour. Med Science.*

When the first edition of this work appeared, about fourteen years ago, Mr Erasmus Wilson had already given some years to the study of Diseases of the Skin, and he then expressed his intention of devoting his future life to the elucidation of this branch of Medical Science In the present edition Mr. Wilson presents us with the results of his matured experience, and we have now before us not merely a reprint of his former publications, but an entirely new and rewritten volume. Thus, the whole history of the diseases affecting the skin, whether they originate in that structure or are the mere manifestations of derangement of internal organs, is brought under notice, and the book includes a mass of information which is spread over a great part of the domain of Medical and Surgical Pathology. We can safely recommend it to the profession as the best work on the subject now in existence in the English language.—*London Med. Times and Gazette.*

No matter what other treatises may be in the library of the medical attendant, he needs the clear and suggestive counsels of Wilson, who is thoroughly posted up on all subjects connected with cutaneous pathology. We have, it is very true, other valuable works on the maladies that invade the skin; but, compared with the volume under consideration, they are certainly to be regarded as inferior lights in guiding the judgment of the medical man.—*Boston Med. and Surg. Journal*, Oct. 1857.

The author adopts a simple and entertaining style. He strives to clear away the complications of his subject, and has thus produced a book filled with a vast amount of information, in a form so agreeable as to make it pleasant reading, even to the uninitiated. More especially does it deserve our praise because of its beautiful and complete atlas, which the American publishers have successfully imitated from the original plates. We pronounce them by far the best imitations of nature yet published in our country. With the text-book and atlas at hand, the diagnosis is rendered easy and accurate, and the practitioner feels himself safe in his treatment. We will add that this work, although it must have been very expensive to the publishers; is not high priced. There is no reason, then, to prevent every physician from obtaining a work of such importance, and one which will save him both labor and perplexity.—*Va. Med. Journal.*

As a practical guide to the classification, diagnosis, and treatment of the diseases of the skin, the book is complete. We know nothing, considered in this aspect, better in our language; it is a safe authority on all the ordinary matters which, in this range of diseases, engage the practitioner's attention, and possesses the high quality—unknown, we believe, to every older manual, of being on a level with science's high-water mark; a sound book of practice.—*London Med. Times.*

ALSO, NOW READY,

A SERIES OF PLATES ILLUSTRATING WILSON ON DISEASES OF THE SKIN; consisting of twenty beautifully executed plates, of which thirteen are exquisitely colored, presenting the Normal Anatomy and Pathology of the Skin, and containing accurate representations of about one hundred varieties of disease, most of them the size of nature. Price in cloth. $4 50.

In beauty of drawing and accuracy and finish of coloring these plates will be found equal to anything of the kind as yet issued in this country. The value of the new edition is enhanced by an additional colored plate.

The plates by which this edition is accompanied leave nothing to be desired, so far as excellence of delineation and perfect accuracy of illustration are concerned.—*Medico-Chirurgical Review.*

Of these plates it is impossible to speak too highly. The representations of the various forms of cutaneous disease are singularly accurate, and the coloring exceeds almost anything we have met with.—*British and Foreign Medical Review.*

We have already expressed our high appreciation of Mr. Wilson's treatise on Diseases of the Skin. The plates are comprised in a separate volume, which we counsel all those who possess the text to purchase. It is a beautiful specimen of color printing, and the representations of the various forms of skin disease are as faithful as is possible in plates of the size.—*Boston Med. and Surg. Journal*, Apr 8, 1858.

Also, the TEXT and PLATES done up in one handsome volume, extra cloth price $7 50.

BY THE SAME AUTHOR.

THE DISSECTOR'S MANUAL; or, Practical and Surgical Anatomy. T[illegible] American, from the last revised and enlarged English edition. Modified and rearrang[illegible] William Hunt, M. D., Demonstrator of Anatomy in the University of Pennsylvania [illegible] large and handsome royal 12mo. volume, extra cloth, of 582 pages, with 154 illustrations [illegible] 2 00.

BY THE SAME AUTHOR.

ON CONSTITUTIONAL AND HEREDITARY SYPHILIS, AN[illegible] ON [illegible] SYPHILITIC ERUPTIONS. In one small octavo volume, extra cloth, beautifully pr[illegible] four exquisite colored plates, presenting more than thirty varieties of syphilitic erupt[illegible]

BY THE SAME AUTHOR.

HEALTHY SKIN; A Popular Treatise on the Skin and Hair, their Preservation and Management. Second American, from the fourth London edition. One neat volume, royal 12mo., extra cloth, of about 300 pages, with numerous illustrations. $1 00 [illegible] 75 cents.

WINSLOW (FORBES), M. D., D. C. L., &c.

ON OBSCURE DISEASES OF THE BRAIN AND DISORDERS OF THE MIND;

their incipient Symptoms, Pathology, Diagnosis, Treatment, and Prophylaxis. In one handsome octavo volume, of nearly 600 pages, extra cloth. $3 00.

We close this brief and necessarily very imperfect notice of Dr. Winslow's great and classical work, by expressing our conviction that it is long since so important and beautifully written a volume has issued from the British medical press.—*Dublin Med. Press*, July 25, 1860.

We honestly believe this to be the best book of the season.—*Ranking's Abstract*, July, 1860.

The latter portion of Dr. Winslow's work is exclusively devoted to the consideration of Cerebral Pathology. It completely exhausts the subject, in the same manner as the previous seventeen chapters relating to morbid psychical phenomena left nothing unnoticed in reference to the mental symptoms premonitory of cerebral disease. It is impossible to overrate the benefits likely to result from a general perusal of Dr. Winslow's valuable and deeply interesting work.—*London Lancet*, June 23, 1860.

It contains an immense mass of information.—*Brit. and For. Med.-Chir. Review*, Oct. 1860.

WEST (CHARLES), M. D.,

Accoucheur to and Lecturer on Midwifery at St. Bartholomew's Hospital, Physician to the Hospital for Sick Children, &c.

LECTURES ON THE DISEASES OF WOMEN.

Second American, from the second London edition. In one handsome octavo volume, extra cloth, of about 500 pages; price $2 50.

⁂ Gentlemen who received the first portion, as issued in the "Medical News and Library," can now complete their copies by procuring Part II, being page 309 to end, with Index, Title matter, &c., 8vo., cloth, price $1.

We must now conclude this hastily written sketch with the confident assurance to our readers that the work will well repay perusal. The conscientious, painstaking, practical physician is apparent on every page.—*N. Y. Journal of Medicine.*

We know of no treatise of the kind so complete and yet so compact.—*Chicago Med. Jour.*

A fairer, more honest, more earnest, and more reliable investigator of the many diseases of women and children is not to be found in any country.—*Southern Med. and Surg. Journal.*

We have to say of it, briefly and decidedly, that it is the best work on the subject in any language; and that it stamps Dr. West as the *facile princeps* of British obstetric authors.—*Edinb. Med. Journ.*

We gladly recommend his Lectures as in the highest degree instructive to all who are interested in obstetric practice.—*London Lancet.*

Happy in his simplicity of manner, and moderate in his expression of opinion, the author is a sound reasoner and a good practitioner, and his book is worthy of the handsome garb in which it has appeared.—*Virginia Med. Journal.*

We must take leave of Dr. West's very useful work, with our commendation of the clearness of its style, and the industry and sobriety of judgment of which it gives evidence.—*London Med Times.*

Sound judgment and good sense pervade every chapter of the book. From its perusal we have derived unmixed satisfaction.—*Dublin Quart. Journ.*

BY THE SAME AUTHOR.

LECTURES ON THE DISEASES OF INFANCY AND CHILDHOOD.

Third American, from the fourth enlarged and improved London edition. In one handsome octavo volume, extra cloth, of about six hundred and fifty pages. $2 75.

The three former editions of the work now before us have placed the author in the foremost rank of those physicians who have devoted special attention to the diseases of early life. We attempt no analysis of this edition, but may refer the reader to some of the chapters to which the largest additions have been made—those on Diphtheria, Disorders of the Mind, and Idiocy, for instance—as a proof that the work is really a new edition; not a mere reprint. In its present shape it will be found of the greatest possible service in the every-day practice of nine-tenths of the profession.—*Med. Times and Gazette*, London, Dec. 10, 1859.

All things considered, this book of Dr. West is by far the best treatise in our language upon such modifications of morbid action and disease as are witnessed when we have to deal with infancy and childhood. It is true that it confines itself to such disorders as come within the province of the *physician*, and even with respect to these it is unequal as regards minuteness of consideration, and some diseases it omits to notice altogether. But those who know anything of the present condition of pædiatrics will readily admit that it would be next to impossible to effect more, or effect it better, than the accoucheur of St. Bartholomew's has done in a single volume. The lecture (XVI.) upon Disorders of the Mind in children is an admirable specimen of the value of the later information conveyed in the Lectures of Dr. Charles West.—*London Lancet*, Oct. 22, 1859.

Since the appearance of the first edition, about eleven years ago, the experience of the author has doubled; so that, whereas the lectures at first were founded on six hundred observations, and one hundred and eighty dissections made among nearly fourteen thousand children, they now embody the results of nine hundred observations, and two hundred and eighty-eight post-mortem examinations made among nearly thirty thousand children, who, during the past twenty years, have been under his care.—*British Med. Journal*, Oct. 1, 1859.

BY THE SAME AUTHOR.

AN ENQUIRY INTO THE PATHOLOGICAL IMPORTANCE OF ULCERATION OF THE OS UTERI.

In one neat octavo volume, extra cloth. $1 00.

WHITEHEAD ON THE CAUSES AND TREATMENT OF ABORTION AND STERILITY. Second American Edition. In one volume, octavo extra cloth, pp. 308. $1 75.

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

H, Cy IV

This book is the property of
COOPER MEDICAL COLLEGE,
SAN FRANCISCO, CAL.

M31 Gross, S. D.
G878 A system of surgery.
v.1 368
1862

NAME	DATE DUE

ATTIC